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Volume III

AEROSPACE STRUCTURES TECHNOLOGY DAMPING DESIGN GUIDE VOLUME III — DAMPING MATERIAL DATA

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This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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This volume contains a summary of the viscoelastic damping material data, presented in the form of reduced temperature nomograms. An example, illustrating the use of the reduced temperature nomograms, is given. A listing of the raw damping material data from which the reduced temperature nomograms were developed is provided. A quick means of identifying the damping materials, by temperature and peak damping value, is included. A list of Vendors, from which the listed damping materials can be obtained, is also included in this volume.

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FORWARD

This report was prepared jointly by the Lockheed-California Company, Burbank, California and the University of Dayton Research Institute, Dayton, Ohio, for the Structural Integrity Branch, Flight Dynamics Laboratory, Air Force Wright Aeronautical Laboratory, Wright-Patterson Air Force Base, Ohio under Contract F33615-81-C-3213, "Aerospace Structures Technology Damping Design Guide." Mr. V. R. Miller of the Structural Integrity Branch was the Project Engineer. Dr. J. Soovere of the Lockheed-California Company was the overall Program Manager and Mr. M. L. Drake was the Program Manager for the University of Dayton. The authors wish to acknowledge the contribution to this report provided by Mr. M. Bouchard, Dr. M. Soni, Mr. M. F. Kluesener, Mr. R. Nash, Mr. R. Dominic, Mr. P. Graf, Mr. D. M. Hopkins and Mr. H. Watkins from the University of Dayton, and by Mr. M. A. Gamon from Lockheed-California Company.

This report consists of three volumes. Volume I provides a summary of the current technology in the application of viscoelastic damping, Volume II is the design guide for viscoelastic damping applications, and Volume III contains the damping material data for use with Volume II.

IMPORTANT NOTICE

TO ALL USERS OF THE

DESIGN GUIDE - VOLUME III

This volume contains a summary of the available damping material data, presented in a simplified format, suitable for use by designers. All information is believed to be accurate, but no guarantee of accuracy or completeness is made. No responsibility is assumed on the batch-to-batch variation of commercially manufactured materials. In every case, the user shall determine before using any material in full-scale production, or in any way, whether such material is suitable for the intended use under particular operating conditions.

All the nomograms and supporting data, including curve fits, were supplied by Dr. L. C. Rogers of AFWAL/FIBAA. Any questions or comments on data or on data presentation should be directed to Dr. Rogers (513) 255-5664/4875.

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SECTION 1
INTRODUCTION

The purpose of this volume is to provide a useful reference containing damping material data. This volume is divided into four sections. The introduction includes a description of the presentation and an example illustrating the use of reduced temperature nomograms.

Section 2 is entitled "Damping Material Properties." This section contains the damping material properties. The data includes all pertinent information currently available, including complex modulus data, thermal gravimetric analysis data, bonding data, etc.

Section 3 is entitled "Material Data for Composites, Metals and Structures." This section contains general property data for various structural materials.

Section 4 contains a list of current damping material manufacturers, addressed, and telephone numbers.

1.1 DAMPING MATERIAL PROPERTIES

The final result of a damping material analysis is a reduced temperature nomogram, which expands the limited number of test results to a graph from which the designer can obtain the damping material's properties (modulus and loss factor) at any given combination of temperature and frequency. The damping material data in Section 2 are given in accordance with the draft standard proposed by ANSI (ASA)/S2-73 entitled "Graphical Presentation of Damping Material Complex Modulus." This standard is contained in Appendix A.

1.2 THE STANDARDIZED MATERIAL DATA

All damping material data are presented in a standardized format in this report. The basic material data are summarized on a cover sheet and the complex modulus data are presented on a reduced temperature nomogram. [1,2] Also included are plots of frequency vs. temperature, imaginary modulus vs. real modulus, and temperature shift function, as well as a listing of damping material data. Included with the listing are the complex modulus curve

parameters for the material. These are the variables used in the analytical equation that represents the modulus curve, loss modulus curve, and loss factor curve that appear on the reduced temperature nomogram. The equation facilitates the use of the damping material properties* in analytical structural design and is shown as follows:

$$G = G_{real} + jG_{imag} = G_e + \frac{G_1}{1 + C_1 \left(\frac{jf_R}{f_1}\right)^{-\alpha_1} + \left(\frac{jf_R}{f_1}\right)^{-\beta_1}}$$

where

$$\eta = \frac{G_{imag}}{G_{real}}$$

and

$$G_e = B(1) \qquad \beta_1 = B(4)$$

$$G_1 = B(2) \qquad c_1 = B(5)$$

$$f_1 = B(3) \qquad \alpha_1 = B(6)$$

*The modulus equation provides modulus as shear or Young's, duplicating that which is displayed on the nomogram.

Please note that the units for G* are MPa and the equation parameters on the cover sheets have the following units:

$$G_e \text{ - MPa}$$
$$G_1 \text{ - MPa}$$
$$f_1 \text{ - Hz's}$$

C, α_1, and β_1 are dimensionless.

1.2.1 Nomogram Cover Sheet

The cover sheet is intended to be used as a quick reference to the damping characteristics and other physical properties required by the designer. A sample cover sheet is shown in Figure 1. The following paragraphs explain each section of the cover sheet.

Part one of the cover sheet lists the damping material's name and the type of modulus (shear modulus (G) or Young's modulus (E)).* Part two contains the peak loss factor and the corresponding modulus as well as the values of the material loss factor and modulus equal to 0.70 of the peak loss factor. The glassy and rubbery modulus values and their corresponding loss factors are also given. Finally, part three gives the temperature at which peak damping occurs and the temperature range over which the damping material loss factor will be greater than or equal to 0.70 of the maximum loss factor. This data is given for frequencies of 10 Hz, 100 Hz, and 1000 Hz and is given in degrees Kelvin, Celsius, and Fahrenheit.

*A list of damping material manufacturers including complete addresses and telephone numbers is contained in Section 4.

1.2.2 The Reduced Nomogram

Figure 2 is a reduced temperature nomogram (RTN). The left-hand scale of the RTN contains the loss factor (η) and modulus; either shear, (G) or Young's, (E). The bottom scale is reduced frequency ($f\alpha_T$). The right-hand scale is a frequency scale and the top oblique scale is temperature. The α_T equation used to generate the RTN is

$$\log \alpha_T = a(1/T-1/T_Z) + 2.303(2a/T_Z-b)\log T/T_Z + b/T_Z-a/T_Z^2-S_{AZ})(T-T_Z)$$

$$-d(\log \alpha_Z)/dT = a(1/T-1/T_Z)^2 + b(1/T-1/T_Z) + S_{AZ}$$

Slope through the three points:

$T_Z = A(1)$	$S_{AZ} = A(4)$
$T_L = A(2)$	$S_{AL} = A(5)$
$T_H = A(3)$	$S_{AH} = A(6)$

$$C_A = (1/T_L-1/T_Z)^2$$

$$C_B = 1/T_L-1/T_Z$$

$$C_C = S_{AL} - S_{AZ}$$

$$D_A = (1/T_H-1/T_Z)^2$$

$$D_B = 1/T_H-1/T_Z$$

$$D_C = S_{AH}-S_{AZ}$$

$$D_E = D_B C_A - C_B D_A$$

$$a = (D_B C_C - C_B D_C)/D_E$$

$$b = (C_A D_C - D_H C_C)/D_E$$

1.2.3 Reading the Reduced Temperature Nomogram

Using Figure 2 as example, the procedure for reading the nomogram is as follows.

Select a combination of temperature and frequency, for example, 280°K and 200 Hz. Find the point for 200 Hz on the right-hand axis. Follow from that point horizontally to the line for 280°K temperature. At this inersection, draw a vertical line which defines $f\alpha_T$. Then draw a vertical line. In this example, modulus G_R(200 Hz, 280°K) = 136 MPa, loss modulus G_I(200 Hz, 280°K) = 116 MPa, and loss factor η(200 Hz, 280°K) = 0.854.

1.2.4 Data Quality Check

In order to document the validity of the damping material data, other properties of the materials are given in other plots in addition to the reduced temperature nomogram. Figure 3 is a plot of frequency as a function of temperature in degrees Kelvin and Fahrenheit. Figure 4 is a plot of loss factor vs. magnitude modulus which can reveal information regarding scatter of the experimental data. The width of the band of data as well as the departure of individual points from the center of the band are indicative of scatter. Acceptable scatter depends on the application. Figure 5 is a listing of the damping material data.

1.2.5 Temperature Shift Function

The temperature shift function is defined by the set of complex modulus data. Because the temperature shift function, $\alpha_T(T)$, has historically had a central role, because its slope, $d(\log \alpha_T)/dT$, is the crucial function that causes data to be correctly shifted, and because the apparent activation energy (ΔH_A) given by

$$\Delta H_A = 2.303RT^2 \, d(\log \alpha_r)/dT$$

where the gas constant is

$$R = 0.00828 \text{ newton} * \text{km/gram} * \text{mole} * \text{deg K}$$

is of interest, these three functions are plotted in Figure 6.

1.3 THERMAL GRAVIMETRIC ANALYSIS OF DAMPING MATERIALS

Thermal Gravimetric Analysis (TGA) data are available for several damping materials. TGA is useful for identifying the temperature at which certain components of the materials volatilize and at which temperature rapid decomposition occurs. The TGA data are included with the cover sheet and the RTN where available.

The TGA plot presents the percentage weight loss, relative to the initial sample weight, as a function of temperature. The zero percent weight loss is at the top of the vertical scale and the scale decreases to 100 percent weight loss (full consumption) at the bottom of the scale. See Figure 7 for an illustration of a typical TGA plot. The plotter is zeroed at the zero percent weight loss line at the beginning of the test. As the test proceeds, the percent weight loss is plotted versus temperature. Percent sample retention also appears on the plots (percent sample retention = 100% - percent weight loss).

Data presented are for tests conducted in both air and nitrogen.

1 ACRYLIC FOAM 18 YOUNG'S

2, 3			GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
2	MTRL LOSS FACTOR		0.2973E-01	0.7077	1.011	0.7077	0.6445
2	MODULUS	MPA	1723.	264.9	25.89	4.059	3.467
		PSI	0.2499E+06	0.3841E+05	3755.	588.6	502.8
3	10.HZ	DEG K		261.0	281.0	307.0	
		DEG C		-32.15	-12.15	13.85	
		DEG F		-25.87	10.13	56.93	
3	100.HZ	DEG K		270.0	294.0	332.0	
		DEG C		-23.15	0.8500	38.85	
		DEG F		-9.670	33.53	101.9	
3	1000.HZ	DEG K		281.0	311.0	350.0	
		DEG C		-12.15	17.85	56.85	
		DEG F		10.13	64.13	134.3	

Figure 1. Sample Cover Sheet

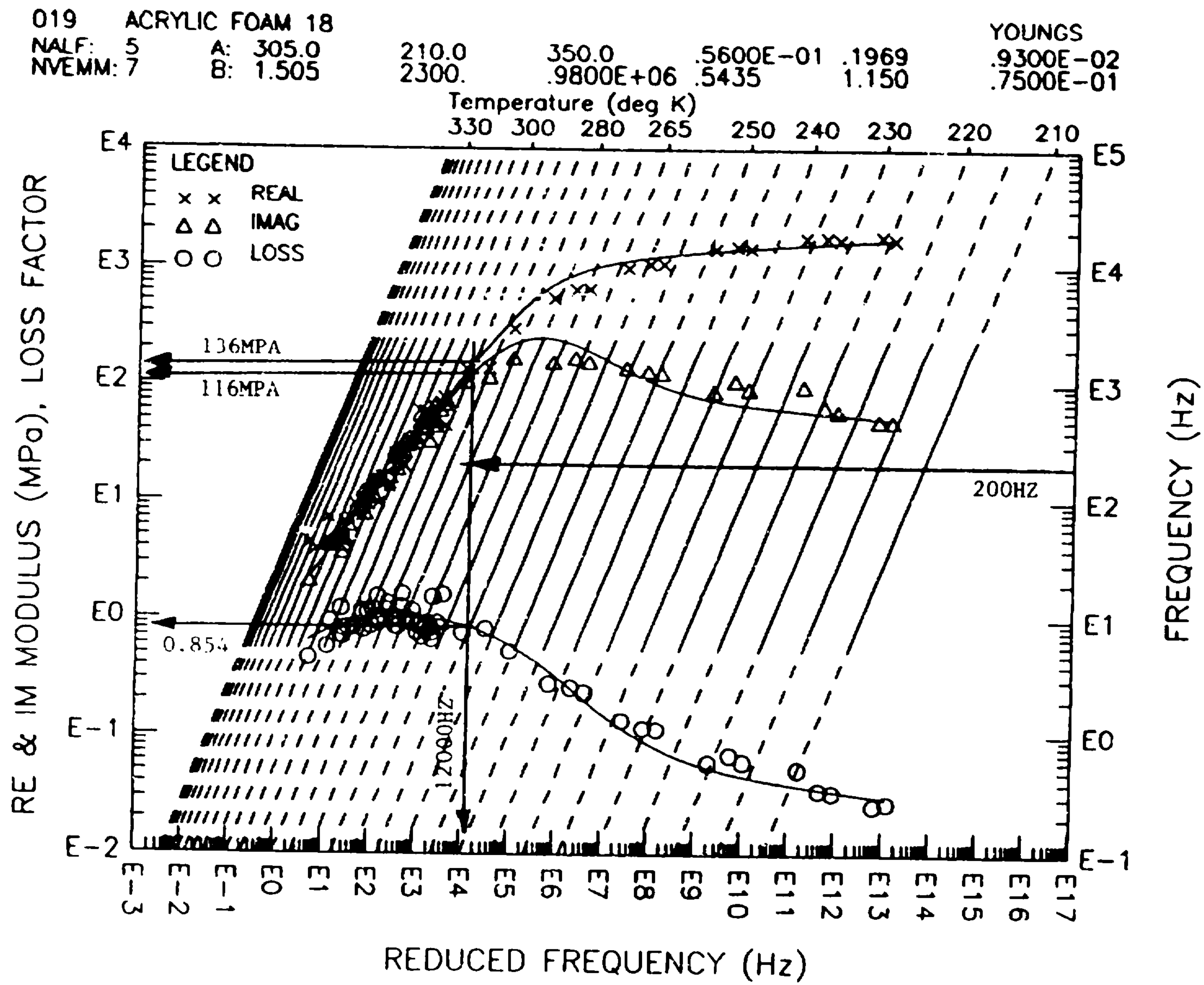


Figure 2. GRAPHICAL PRESENTATION OF DAMPING MATERIAL COMPLEX MODULUS

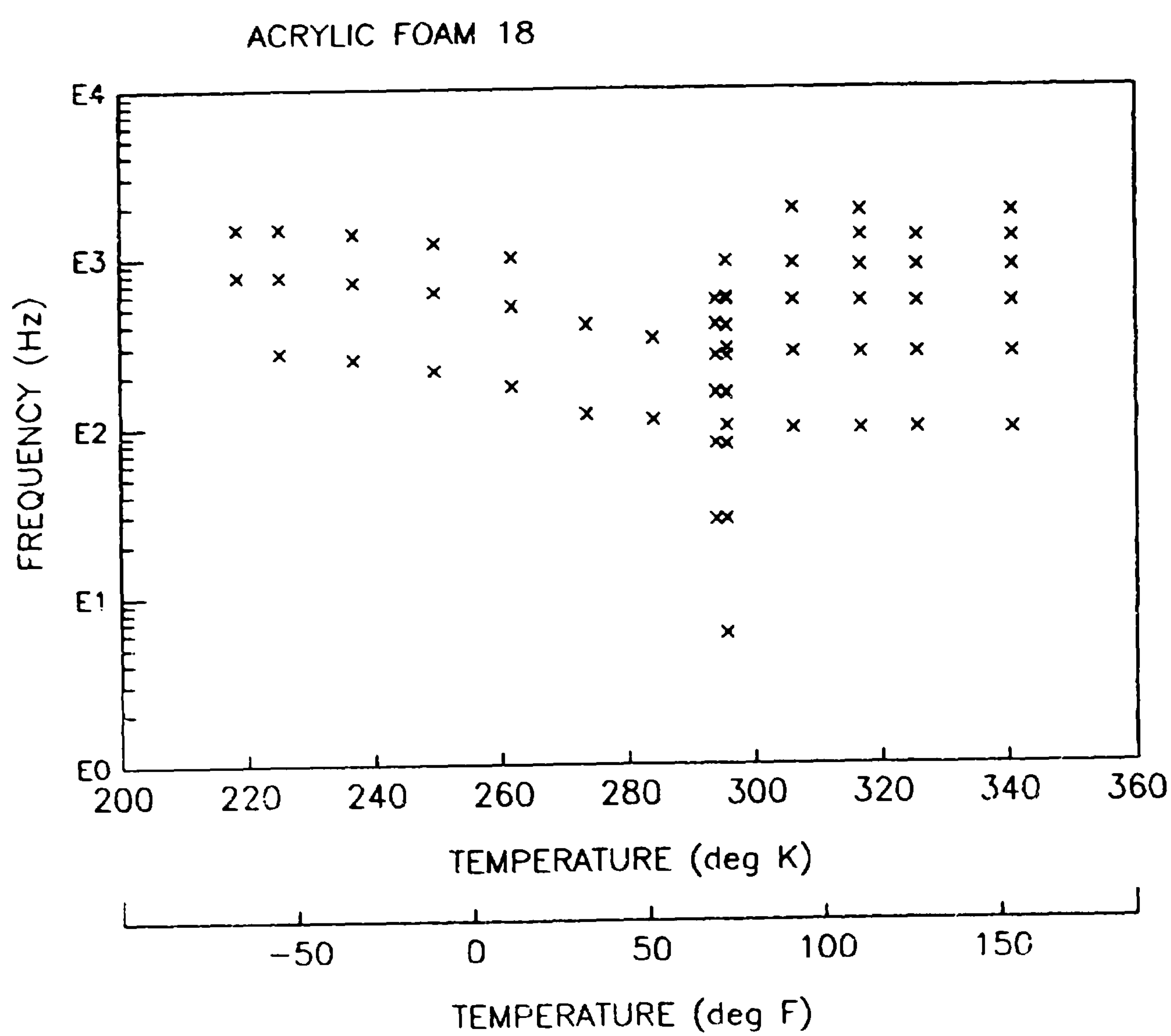


Figure 3. Frequency vs. Temperature Plot

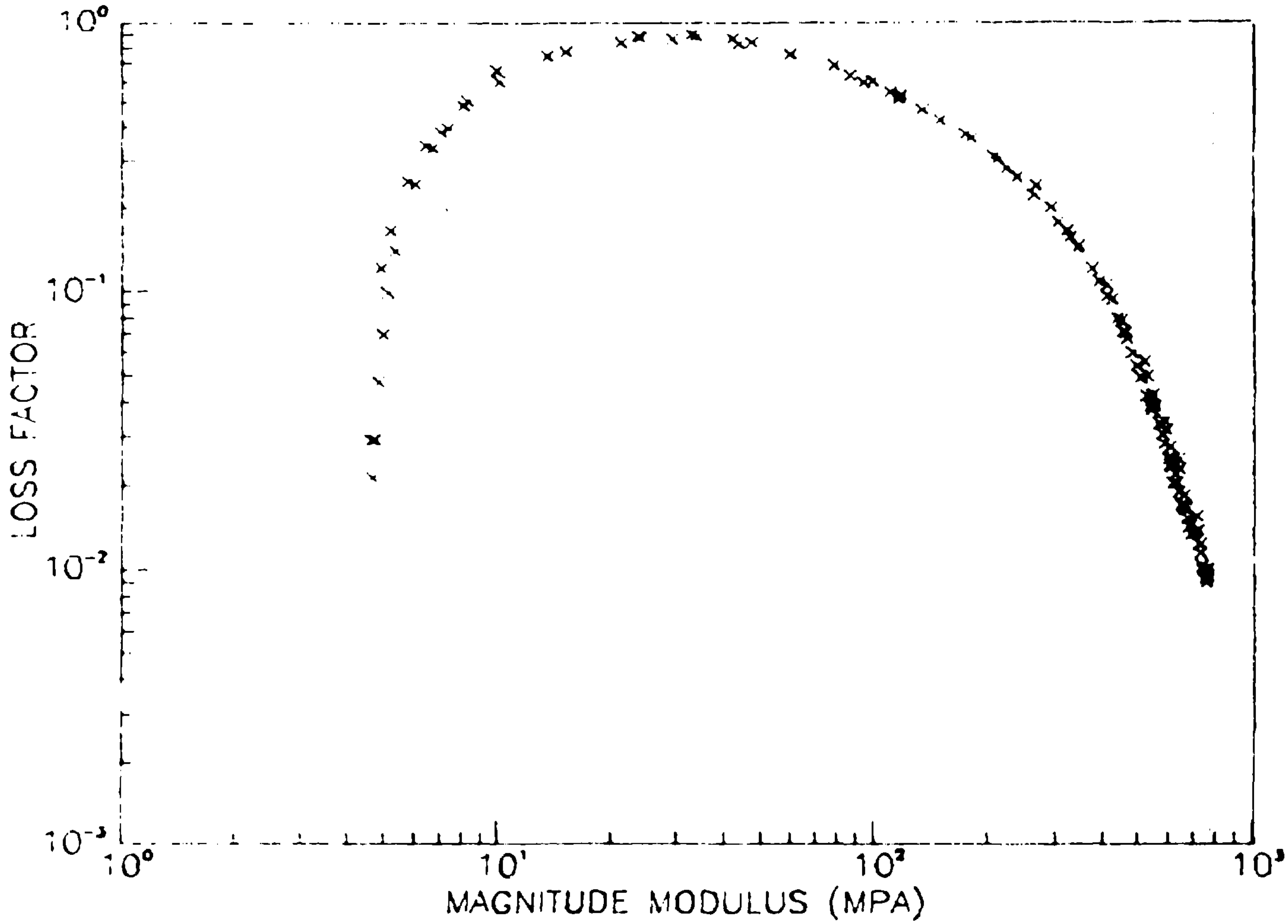


Figure 4. DATA QUALITY CHECK

ACRYLIC FOAM 18 YOUNG'S

ALFA-T MODEL							
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	305.0	210.0	350.0	0.5600E-01	0.1969	0.9300E-02

COMPLEX MODULUS MODEL							
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	1.505	2300.	0.9800E+06	0.5435	1.150	0.7500E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
340.4	95.91	4.398	0.4551	2.002
340.4	267.2	4.264	0.9318	3.973
340.4	522.9	6.567	0.6991	4.591
340.4	863.1	9.346	0.8312	7.768
340.4	1273.	10.44	1.093	11.41
340.4	1791.	10.76	1.134	12.20
325.4	96.66	7.092	0.5700	4.042
325.4	269.4	6.990	0.8344	5.832
325.4	525.0	7.254	1.147	8.320
325.4	870.8	12.47	0.8546	10.66
325.4	1291.	15.90	0.9157	14.56
316.5	96.41	4.924	0.8163	4.019
316.5	271.0	9.241	0.7943	7.340
316.5	533.9	14.99	1.004	15.05
316.5	873.1	13.04	1.165	15.19
316.5	1305.	20.73	0.8571	17.77
316.5	1830.	19.40	1.604	31.12
305.9	97.39	9.077	1.123	10.19
305.9	274.0	13.92	1.334	18.57
305.9	540.1	20.01	1.239	24.79
305.9	903.5	29.88	1.157	34.57
305.9	1886.	34.23	0.9033	30.92
295.4	100.6	25.07	1.010	25.32
295.4	289.8	43.67	0.9056	39.55
295.4	564.7	43.51	1.499	65.22
295.4	929.0	44.29	1.586	70.24
283.7	110.1	77.00	0.8375	64.49
283.7	331.8	132.4	0.7537	99.79
273.2	119.6	134.3	0.8134	109.2
273.2	398.7	299.5	0.5246	157.1
261.5	171.5	534.0	0.2730	145.8
261.5	505.5	630.2	0.2537	159.9
261.5	993.7	637.8	0.2305	147.0
249.3	214.7	976.0	0.1340	130.8
249.3	617.9	1063.	0.1153	122.6
249.3	1213.	1068.	0.1123	119.9
236.5	252.1	1438.	0.5860E-01	84.27
236.5	716.9	1516.	0.6790E-01	102.9
236.5	1386.	1470.	0.5980E-01	87.91
224.8	276.0	1772.	0.5210E-01	92.32

Figure 5. Data Listing

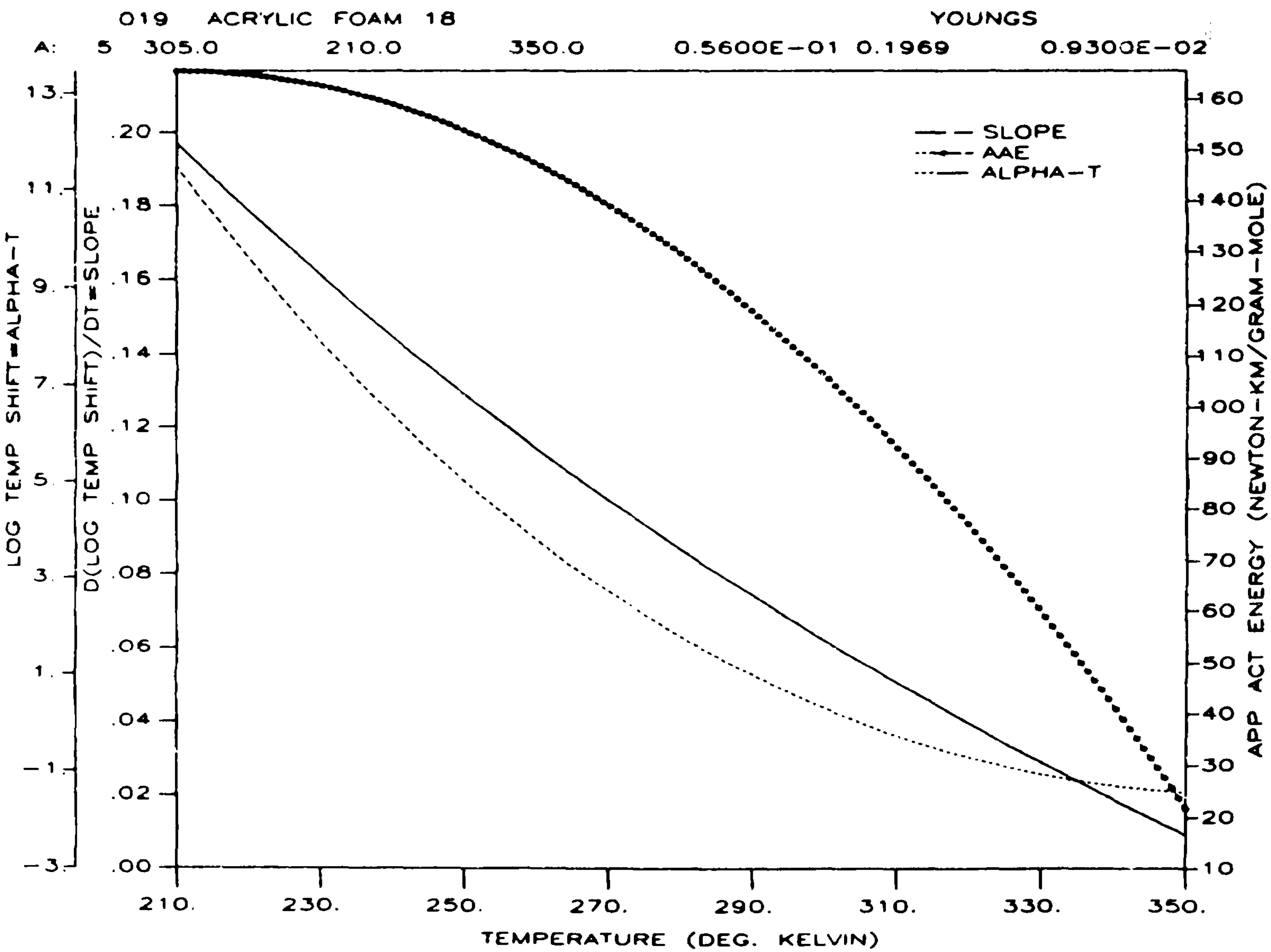


Figure 6 TEMPERATURE SHIFT FUNCTION AND ITS PROPERTIES

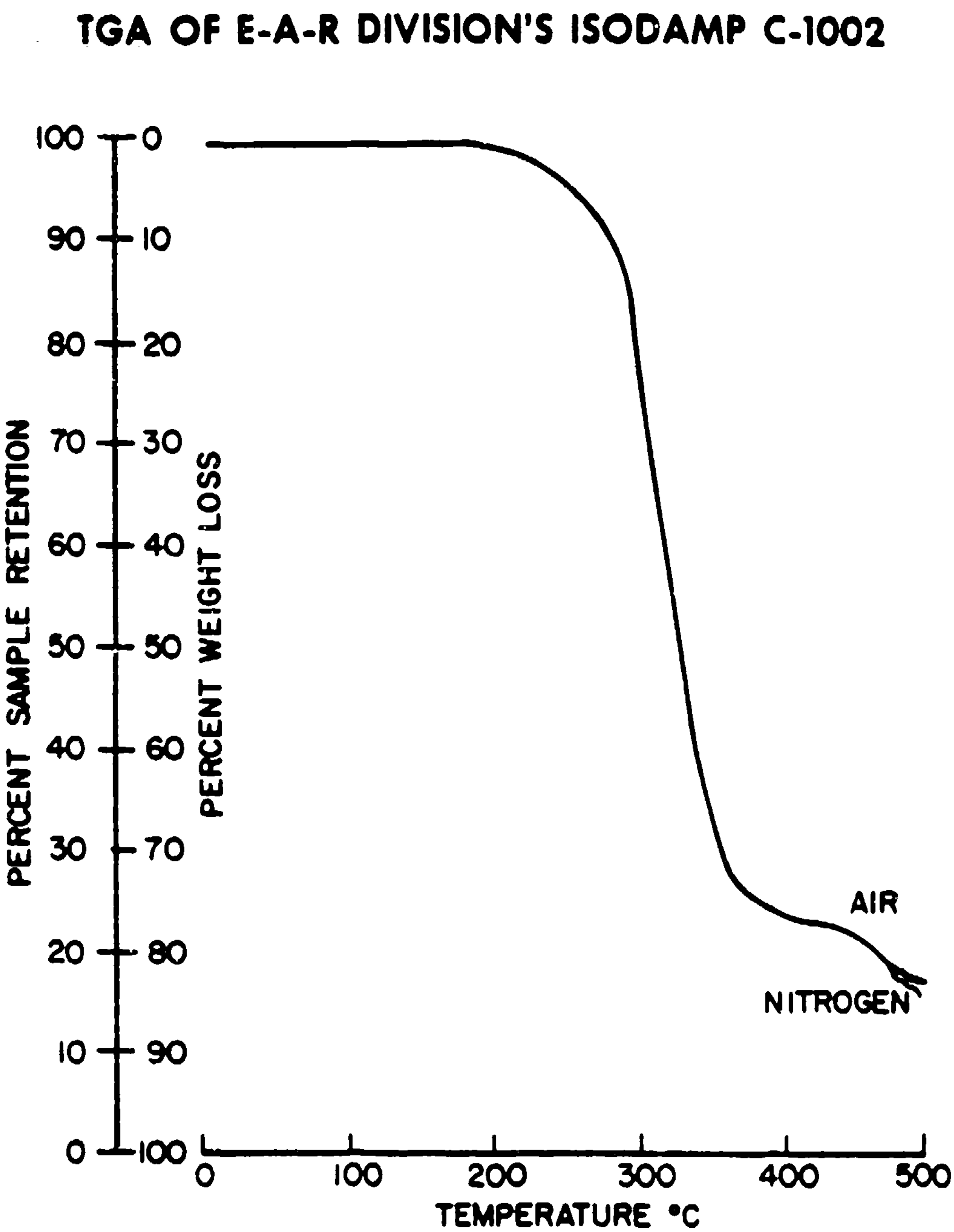


Figure 7 Typical TGA Plot

SECTION 2

DAMPING MATERIAL PROPERTY DATA

This section contains the damping mater· ·:roperties for the various materials. The data is presented in a standardized format: the cover sheet, nomogram, frequency plot, modulus plot, temperature shift function plot, and data list. A quick reference figure for the damping materials is given in Figure 8 . The figure illustrates the temperature range over which the material loss factor is above seventy percent of the maximum loss factor. Also shown is the temperature of maximum damping (indicated by the triangle, Δ) and the value of maximum damping at a frequency of 100 Hz, as well as the page on which the material data is found. The user should note that the temperature range shown in Figure 8 can be misleading for the following reasons:

1. the effective temperature range of a damping design is dependent on the damping material modulus as well as the loss factor.

2. The numeric value of loss factor used to determine the temperature range shown in Figure 8 varies from material to material.

Table 1 lists the damping material trade names, the manufacturer of the material, and the page number in Section 2 where the material data is presented.

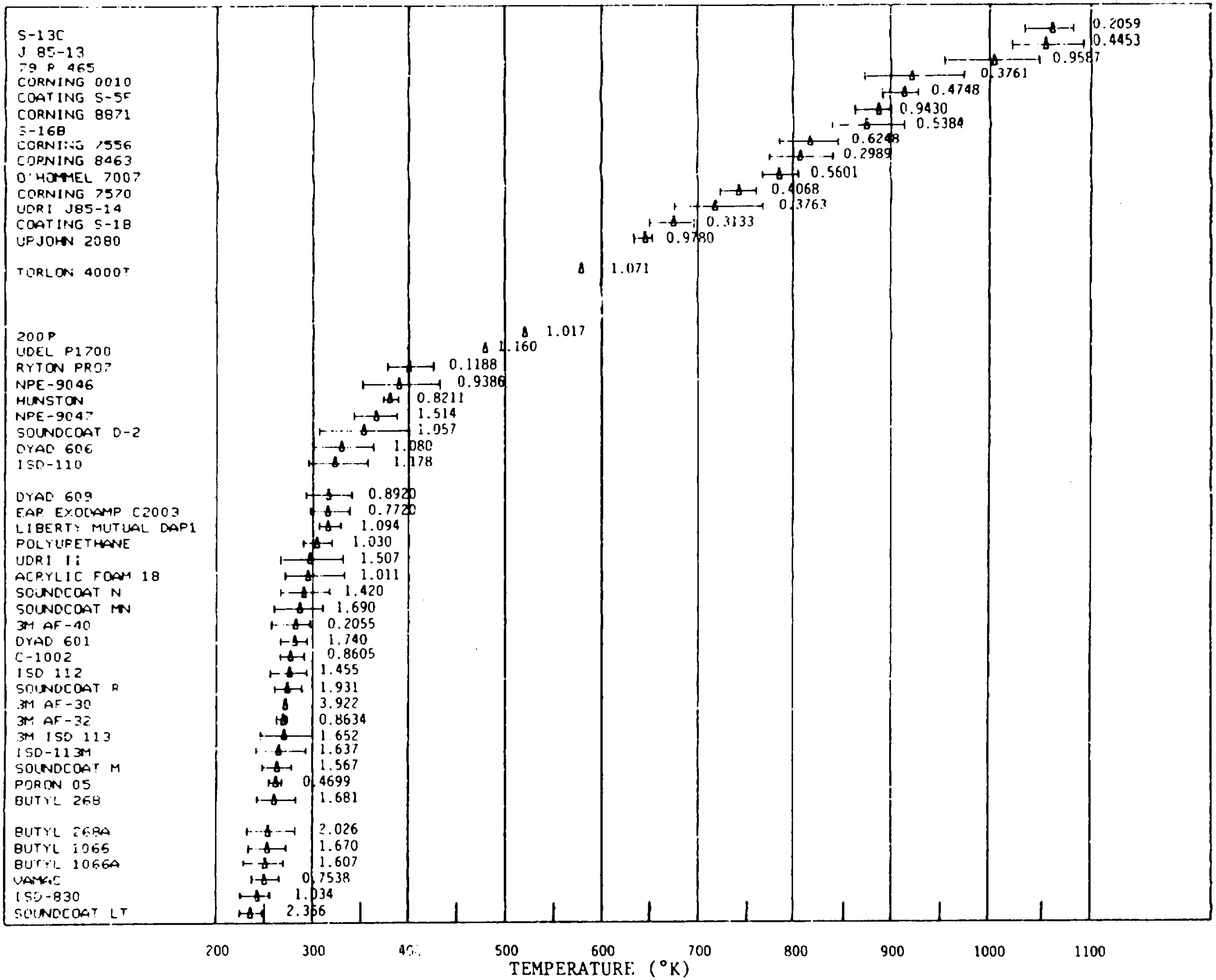


Figure 8. Quick Reference Chart for Damping Materials

TABLE 1

MATERIALS, MANUFACTURERS, AND PAGE NUMBERS

Manufacturer	Material	Page Number
Soundcoat	LT	17
3M	ISD-830	26
Dupont	Vamac	36
UDRI	Butyl 1066A	45
UDRI	Butyl 1066	54
UDRI	Butyl 268A	63
UDRI	Butyl 268	72
Rogers	PORON 05	80
Soundcoat	M	89
3M	ISD-113M	98
3M	ISD-113	107
3M	AF-32	117
3M	AF-30	125
Soundcoat	R	133
3M	ISD-112	142
E-A-R	C-1002	152
Soundcoat	DYAD 601	162
3M	AF-40	171
Soundcoat	MN	180
Soundcoat	N	189
3M	Acrylic Foam 18	199
UDRI	UDRI II	208
-----	Polyurethane	217
Allforce Acoustics	DAP-1	227
E-A-R	C2003	236
Soundcoat	DYAD 609	245
3M	ISD-110	253
Soundcoat	DYAD 606	263
Soundcoat	D	271
3M	NPE-9047	281
-----	Hunston	290
3M	NPE-9046	300
Phillips Petroleum	Ryton PR07	310
Union Carbide	Udel P1700	319
ICI Americas	200P	328
Amoco	Torlon 4000T	338
Upjohn	2080	340
Solar	S-1B	356
UDRI	J85-14	365
Corning	7570	374
O'Hommel	7007	382
Corning	8463	390
Corning	7556	398
Solar	S-16B	407
Corning	8871	416
Solar	S-5F	424
Corning	0010	433
Pemco	79R465	441
UDRI	J85-13	450
Solar	S-1[illegible]C	459

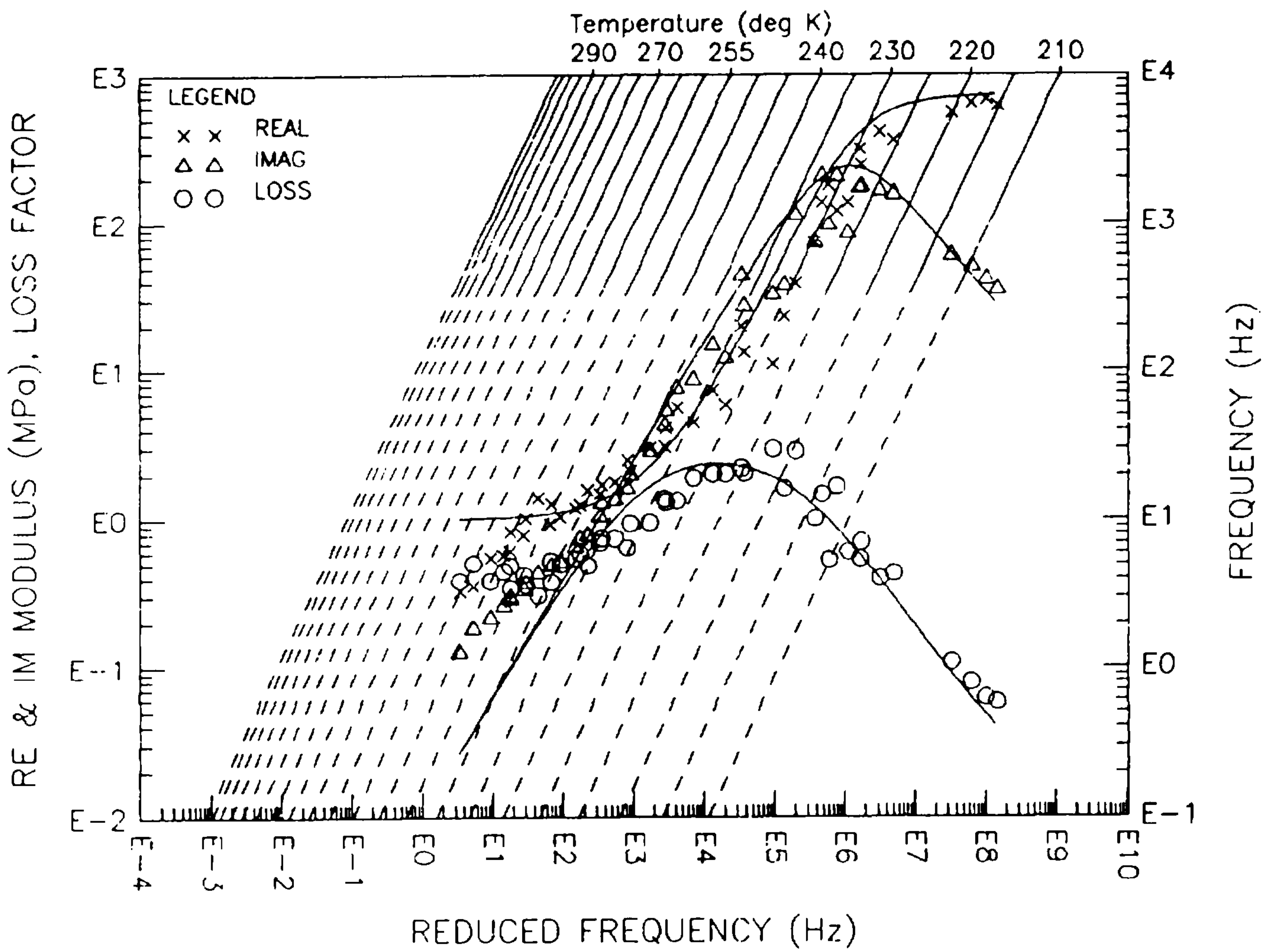
SOUNDCOAT LT

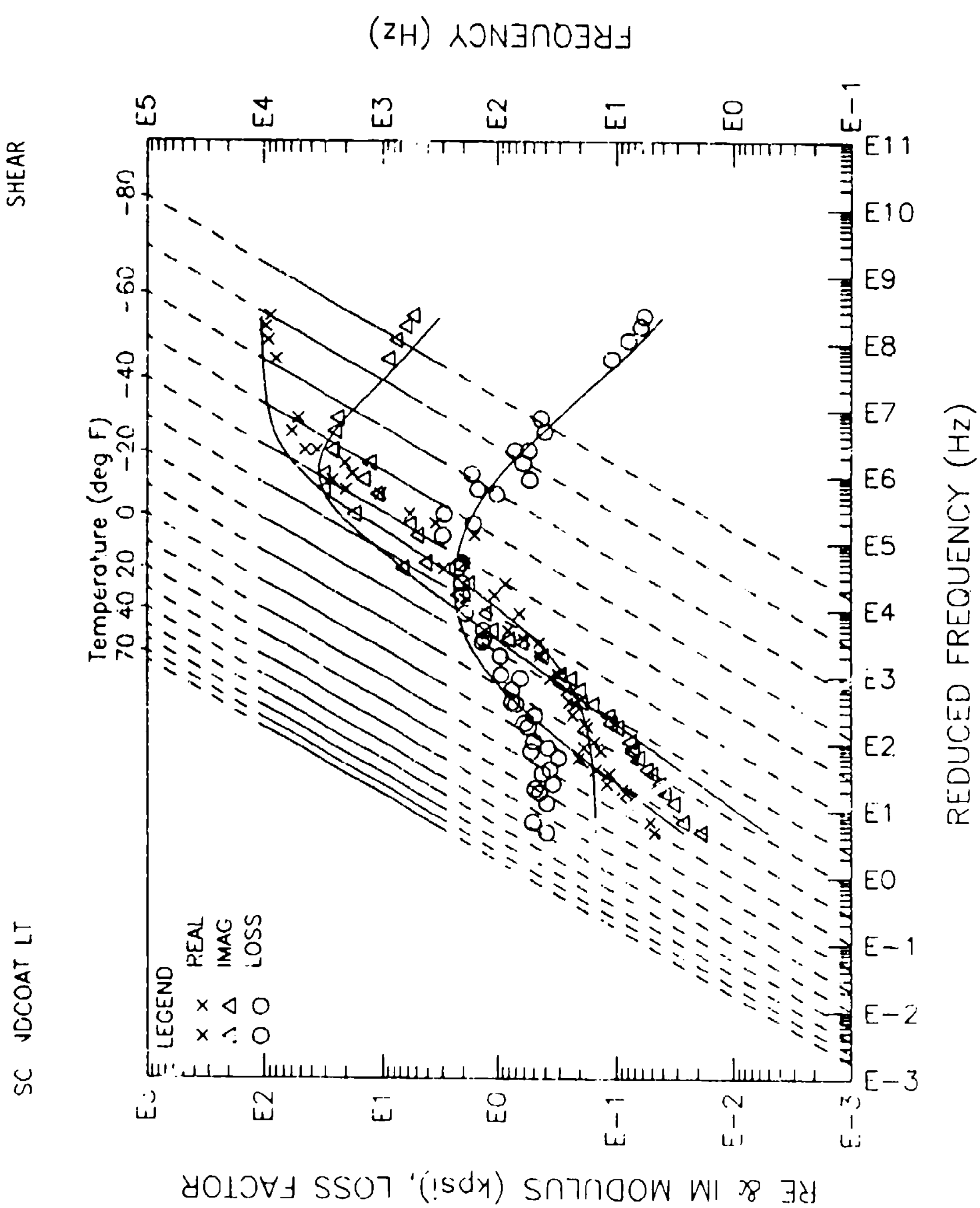
SHEAR

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.3908E-01	1.656	2.366	1.656	0.2631E-01
MODULUS	MPA	715.5	82.98	9.588	2.329	1.009
	PSI	0.1038E+06	0.1203E+05	1391.	337.8	146.3
10.HZ	DEG K		216.0	225.0	234.0	
	DEG C		-77.15	-68.15	-59.15	
	DEG F		-106.9	-90.67	-74.47	
100.HZ	DEG K		224.0	235.0	244.0	
	DEG C		-69.15	-58.15	-49.15	
	DEG F		-92.47	-72.67	-56.47	
1000.HZ	DEG K		234.0	245.0	257.0	
	DEG C		-59.15	-48.15	-36.15	
	DEG F		-74.47	-54.67	-33.07	

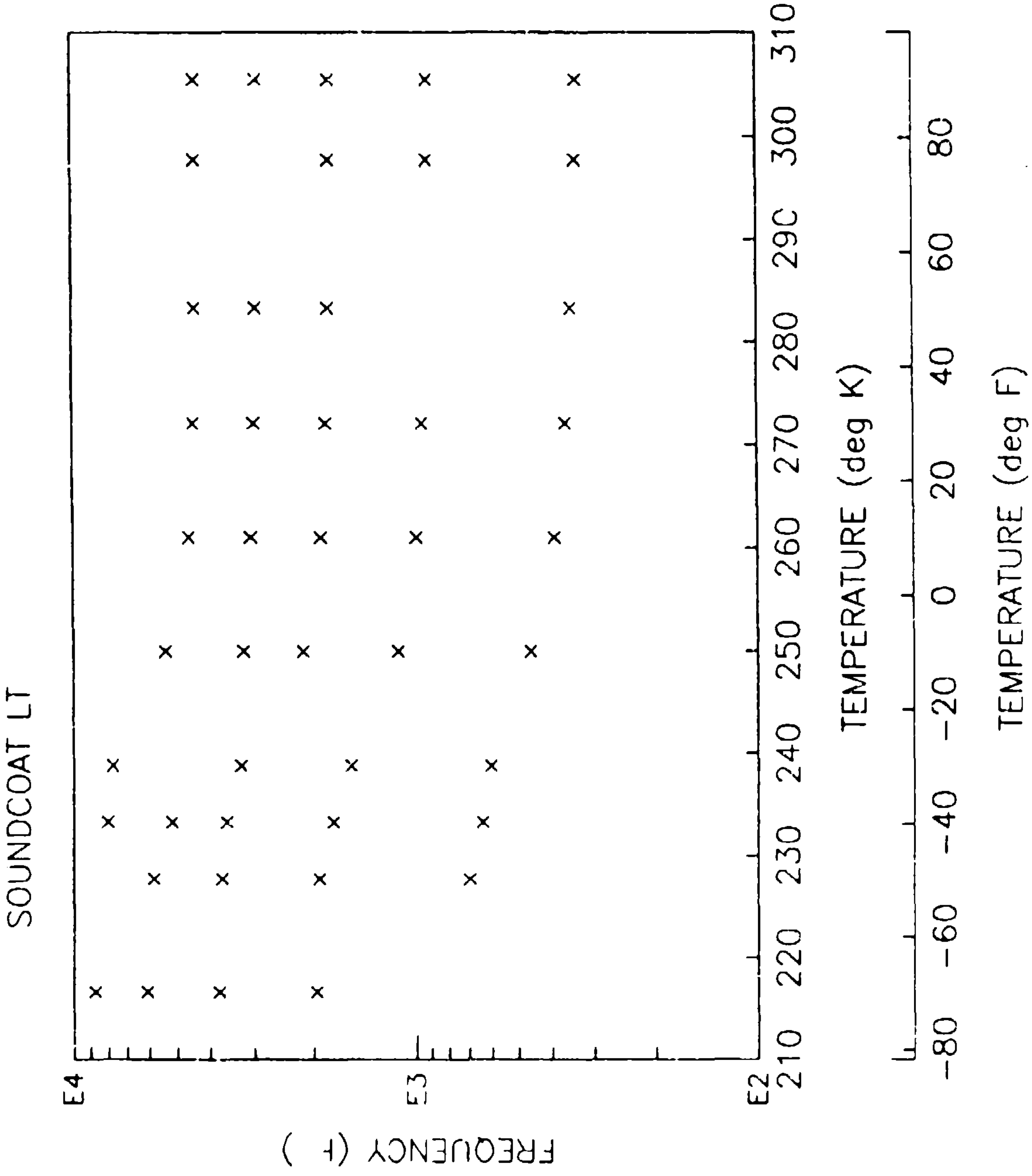
SOUNDCOAT LT

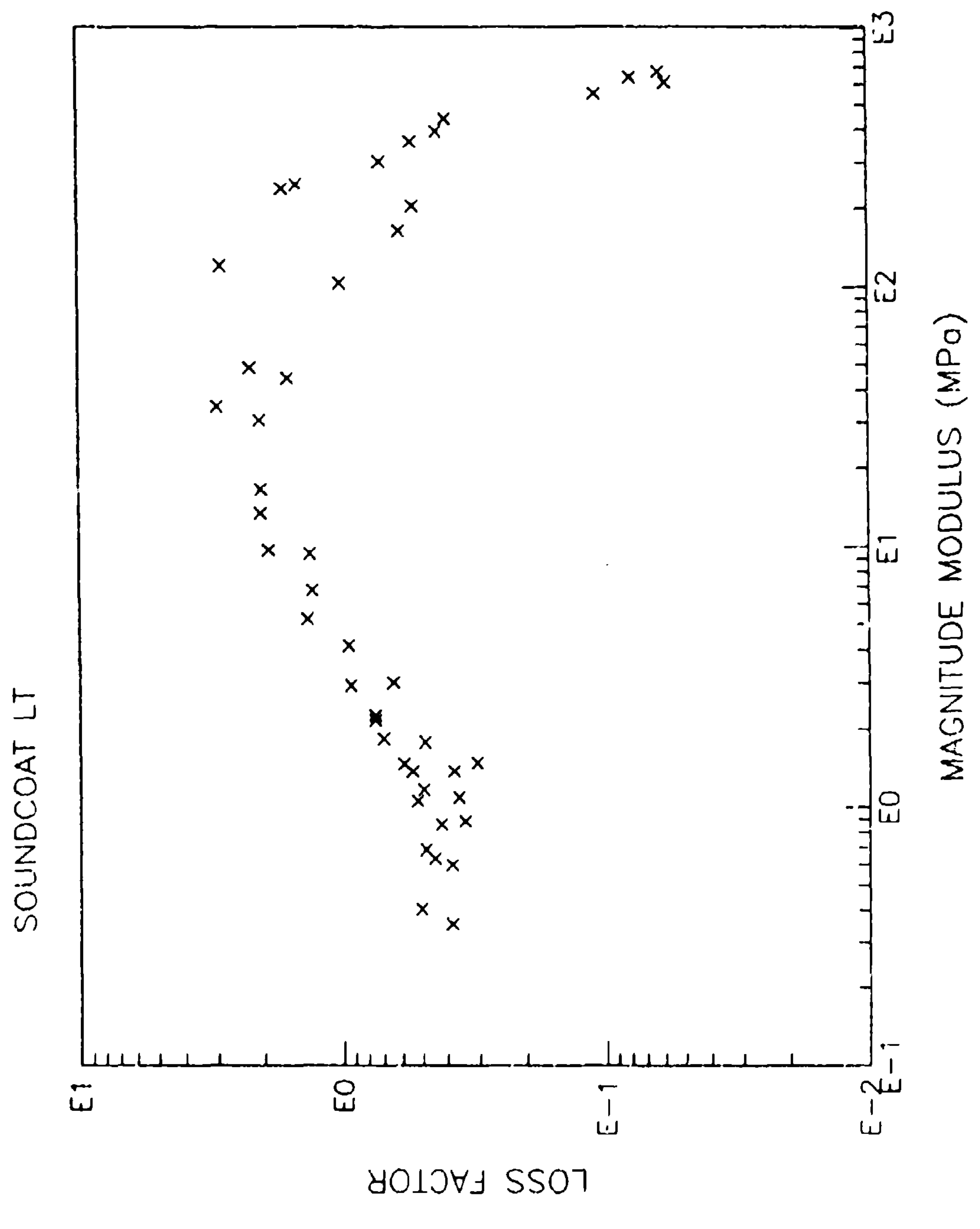
SHEAR



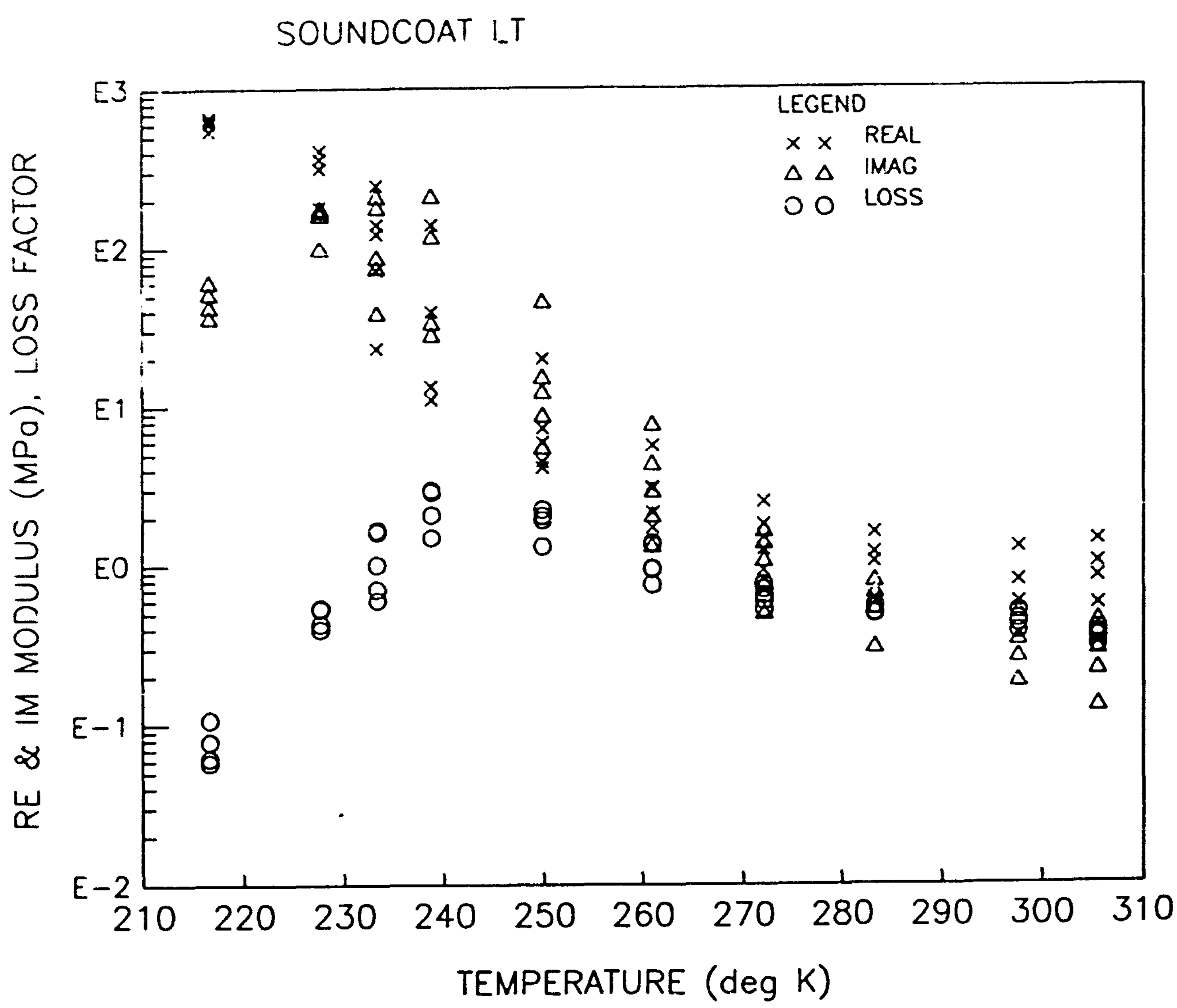


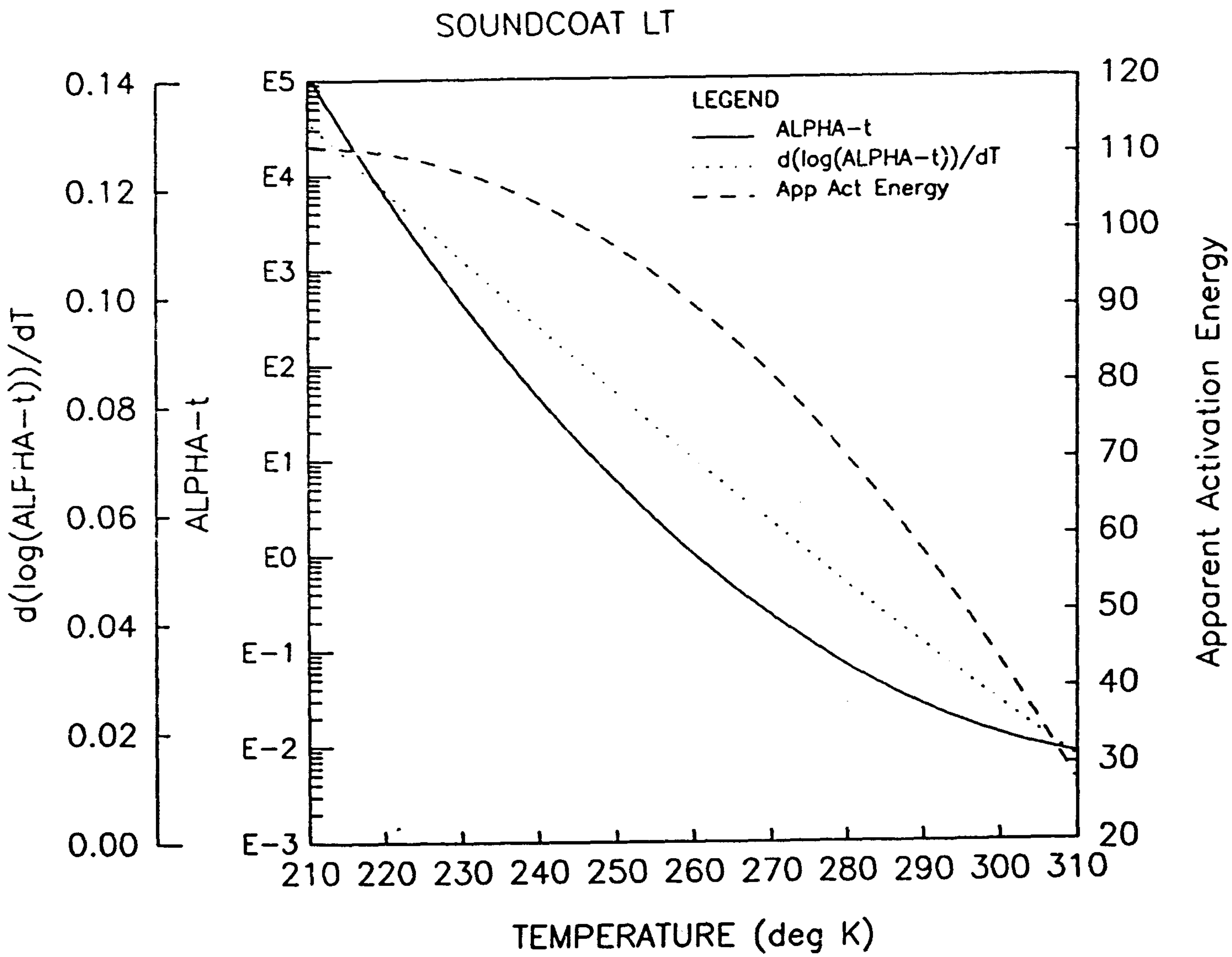
SC JDCOAT LT
SHEAR
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
Temperature (deg F)
70 40 20 0 -20 -40 -60 -80
RE & IM MODULUS (kpsi), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)


SOUNDCOAT LT
FREQUENCY (H)
E4
E3
E2
210
220
230
240
250
260
270
280
290
300
310
TEMPERATURE (deg K)
-80
-60
-40
-20
0
20
40
60
80
TEMPERATURE (deg F)



SOUNDCOAT LT
LOSS FACTOR
MAGNITUDE MODULUS (MPa)
E1
E0
E−1
E−2
E−1
E0
E1
E2
E3


SOUNDCOAT LT
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
210
220
230
240
250
260
270
280
290
300
310
TEMPERATURE (deg K)



SOUNDCOAT LT
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
ALPHA-t
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
Apparent Activation Energy
120
110
100
90
80
70
60
50
40
30
20
210
220
230
240
250
260
270
280
290
300
310
TEMPERATURE (deg K)

SOUNDCOAT LT SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	260.0	210.0	310.0	0.7000E-01	0.1322	0.1500E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	1.000	750.0	0.1120E+07	0.8000	0.2000	0.3000

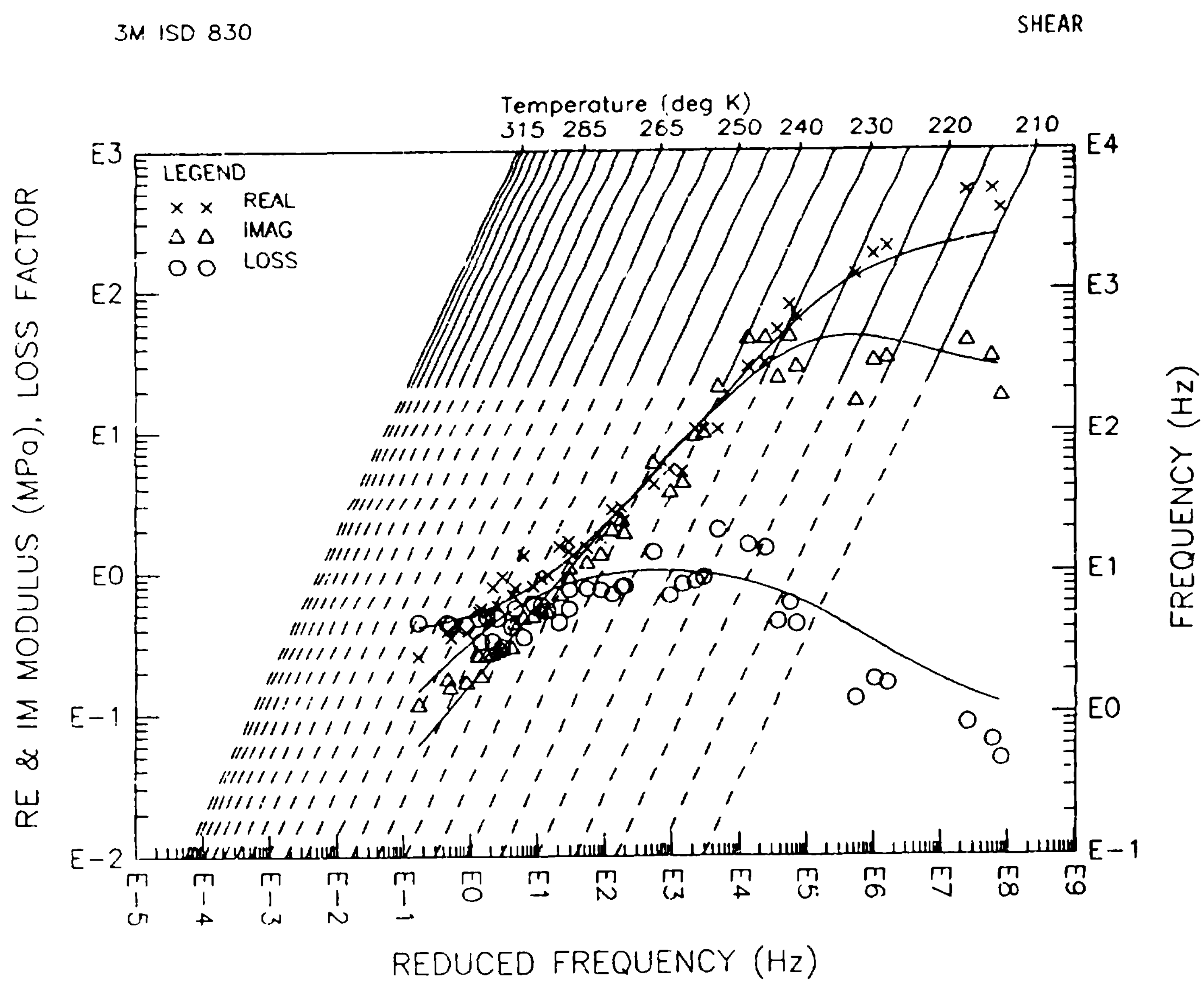
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
305.4	335.7	0.3278	0.3850	0.1262
305.4	916.7	0.5550	0.3849	0.2136
305.4	1783.	0.8281	0.3435	0.2845
305.4	2933.	1.016	0.3626	0.3684
305.4	4376.	1.402	0.3077	0.4314
297.6	337.8	0.3565	0.5075	0.1804
297.6	919.4	0.5746	0.4489	0.2579
297.6	1784.	0.7847	0.4230	0.3319
297.6	4377.	1.278	0.3780	0.4831
283.2	350.3	0.6119	0.4870	0.2980
283.2	1803.	1.038	0.4969	0.5158
283.2	2959.	1.191	0.5488	0.6536
283.2	4408.	1.582	0.4906	0.7761
272.0	364.0	0.9267	0.5253	0.4868
272.0	957.0	1.251	0.5924	0.7411
272.0	1829.	1.493	0.6993	1.044
272.0	2996.	1.796	0.7514	1.350
272.0	4462.	2.500	0.6446	1.611
260.9	392.3	1.713	0.7519	1.288
260.9	1000.	2.126	0.9340	1.986
260.9	1900.	3.000	0.9492	2.848
260.9	3067.	3.079	1.373	4.227
260.9	4619.	5.598	1.336	7.479
249.8	459.6	4.091	1.307	5.347
249.8	1134.	4.471	1.908	8.531
249.8	2140.	7.295	2.030	14.81
249.8	3220.	5.883	2.038	11.99
249.8	5390.	19.91	2.220	44.20
238.7	607.0	13.29	2.060	27.38
238.7	1565.	10.96	2.964	32.49
238.7	3271.	39.28	2.873	112.9
238.7	7773.	137.5	1.483	203.9
233.2	641.0	23.27	1.618	37.65
233.2	1761.	72.26	1.012	73.13
233.2	3571.	121.6	1.675	203.7
233.2	5180.	139.1	0.6059	84.28
233.2	8020.	246.3	0.7091	174.7
227.6	695.9	179.1	0.5340	95.64
227.6	1928.	315.1	0.5441	171.4
227.6	3685.	409.8	0.3991	163.6

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
227.6	5818.	361.2	0.4313	155.8
216.5	1959.	548.3	0.1082	59.33
216.5	3763.	635.5	0.7921E-01	50.34
216.5	6079.	668.1	0.6215E-01	41.52
216.5	8719.	608.2	0.5822E-01	35.41

3M ISD 830 SHEAR

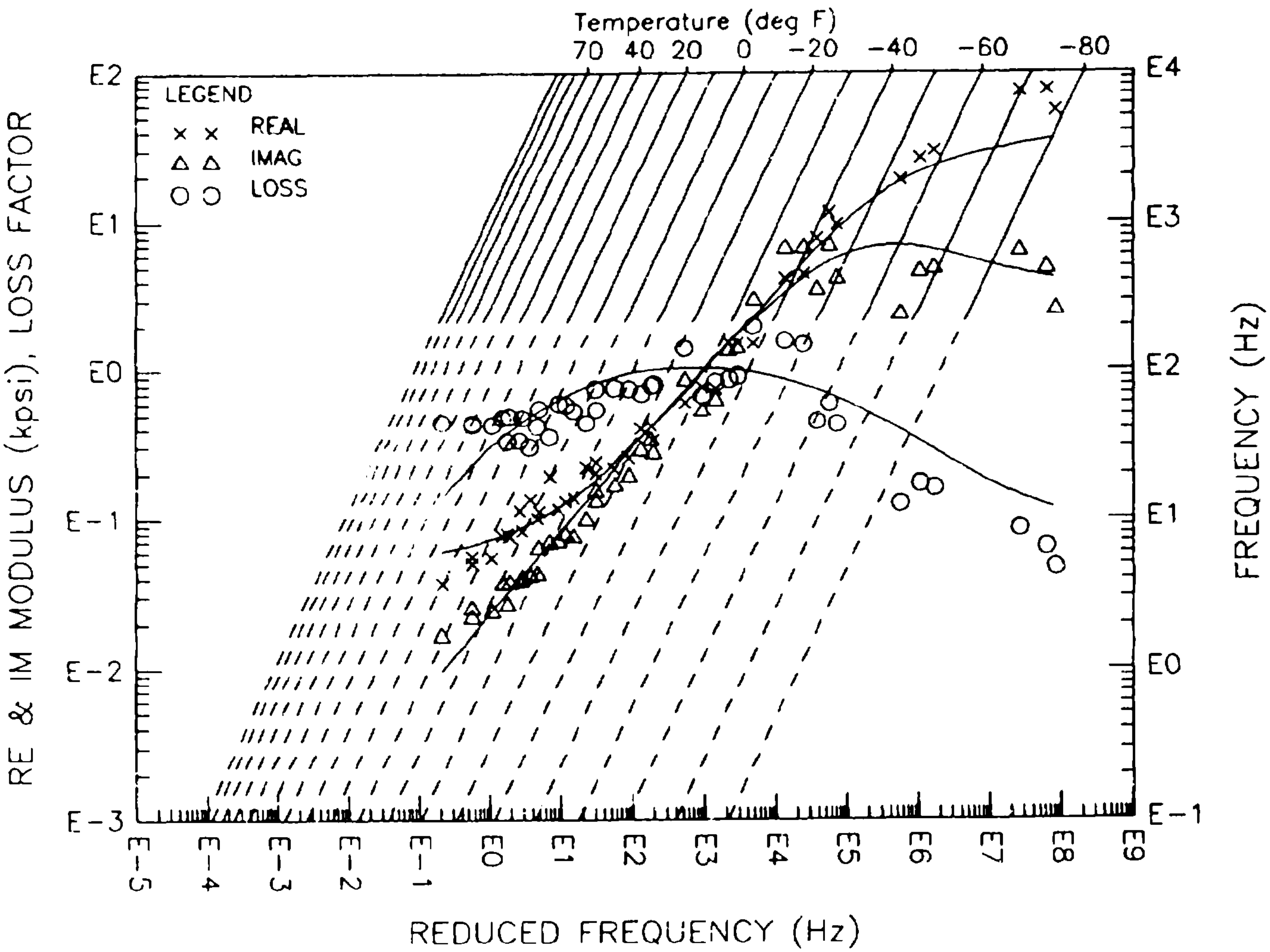
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1177	0.7240	1.034	0.7240	0.1449
MODULUS	MPA	246.8	50.01	5.163	0.9943	0.4160
	PSI	0.3579E+05	7253.	748.9	144.2	60.33
10.HZ	DEG K		216.0	232.0	248.0	
	DEG C		-77.15	-61.15	-45.15	
	DEG F		-106.9	-78.07	-49.27	
100.HZ	DEG K		224.0	242.0	261.0	
	DEG C		-69.15	-51.15	-32.15	
	DEG F		-92.47	-60.07	-25.87	
1000.HZ	DEG K		233.0	253.0	277.0	
	DEG C		-60.15	-40.15	-16.15	
	DEG F		-76.27	-40.27	2.930	

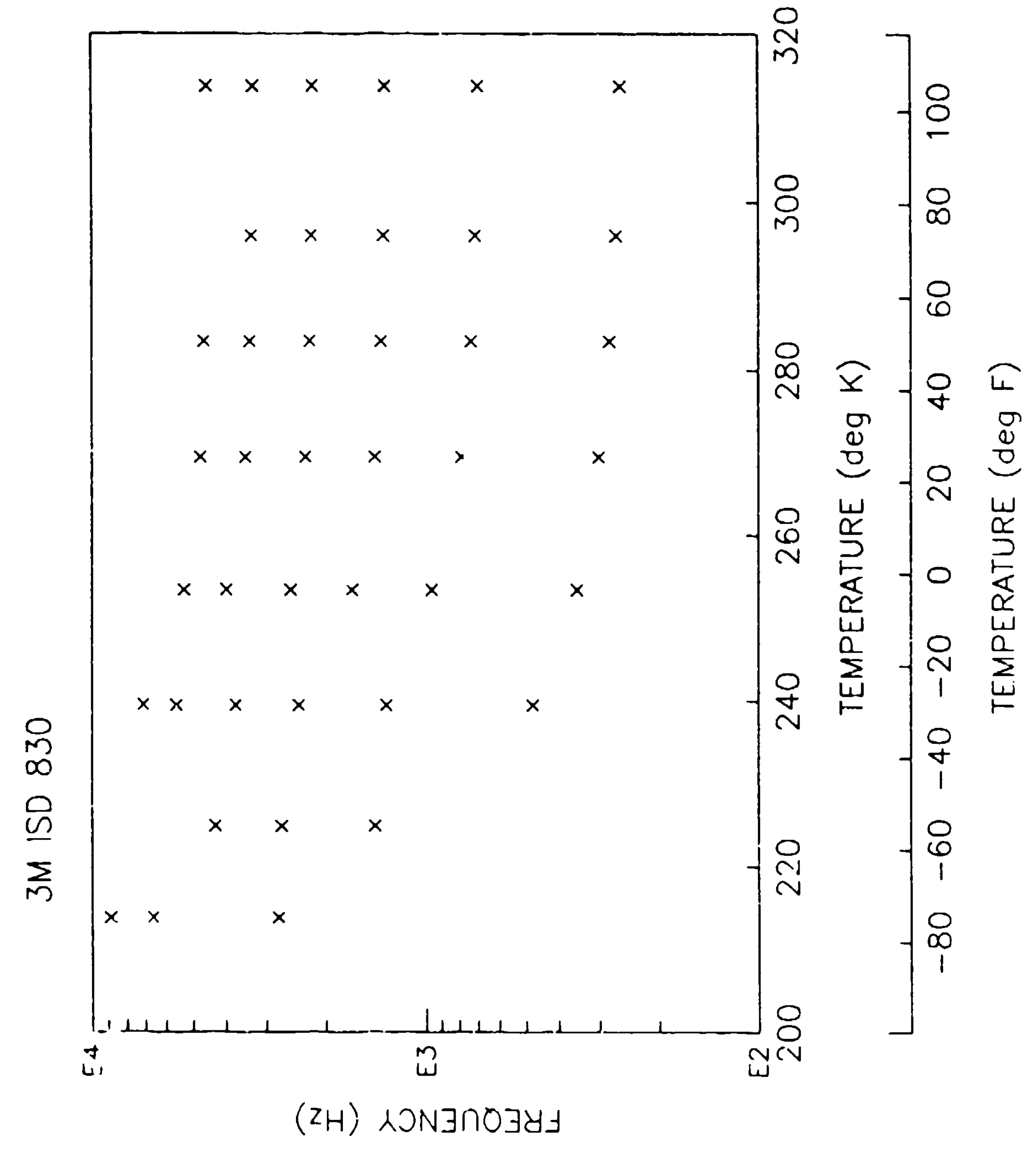


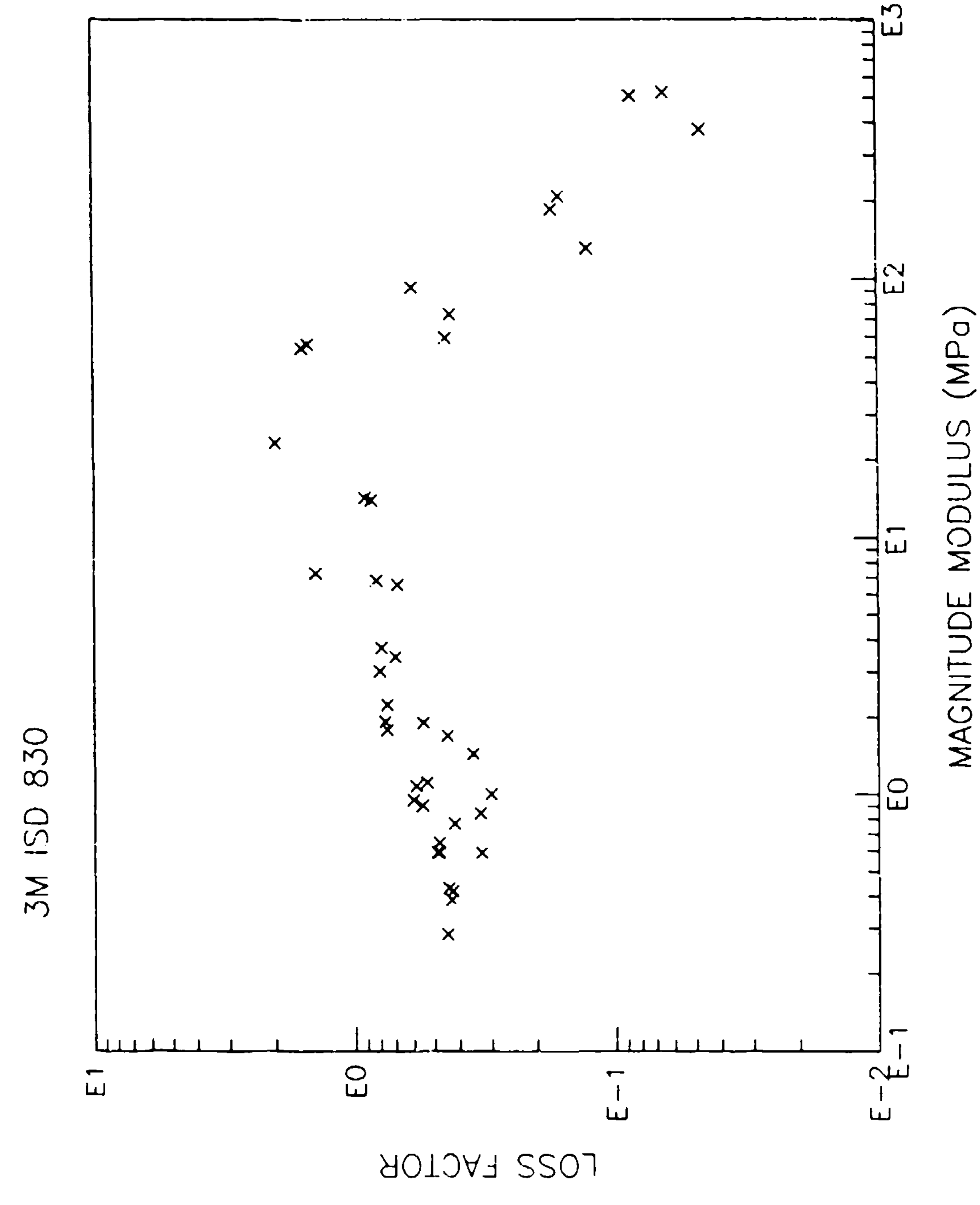
3M ISD 830
SHEAR
Temperature (deg K)
315 285 265 250 240 230 220 210
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E4 E3 E2 E1 E0 E−1
E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9
REDUCED FREQUENCY (Hz)

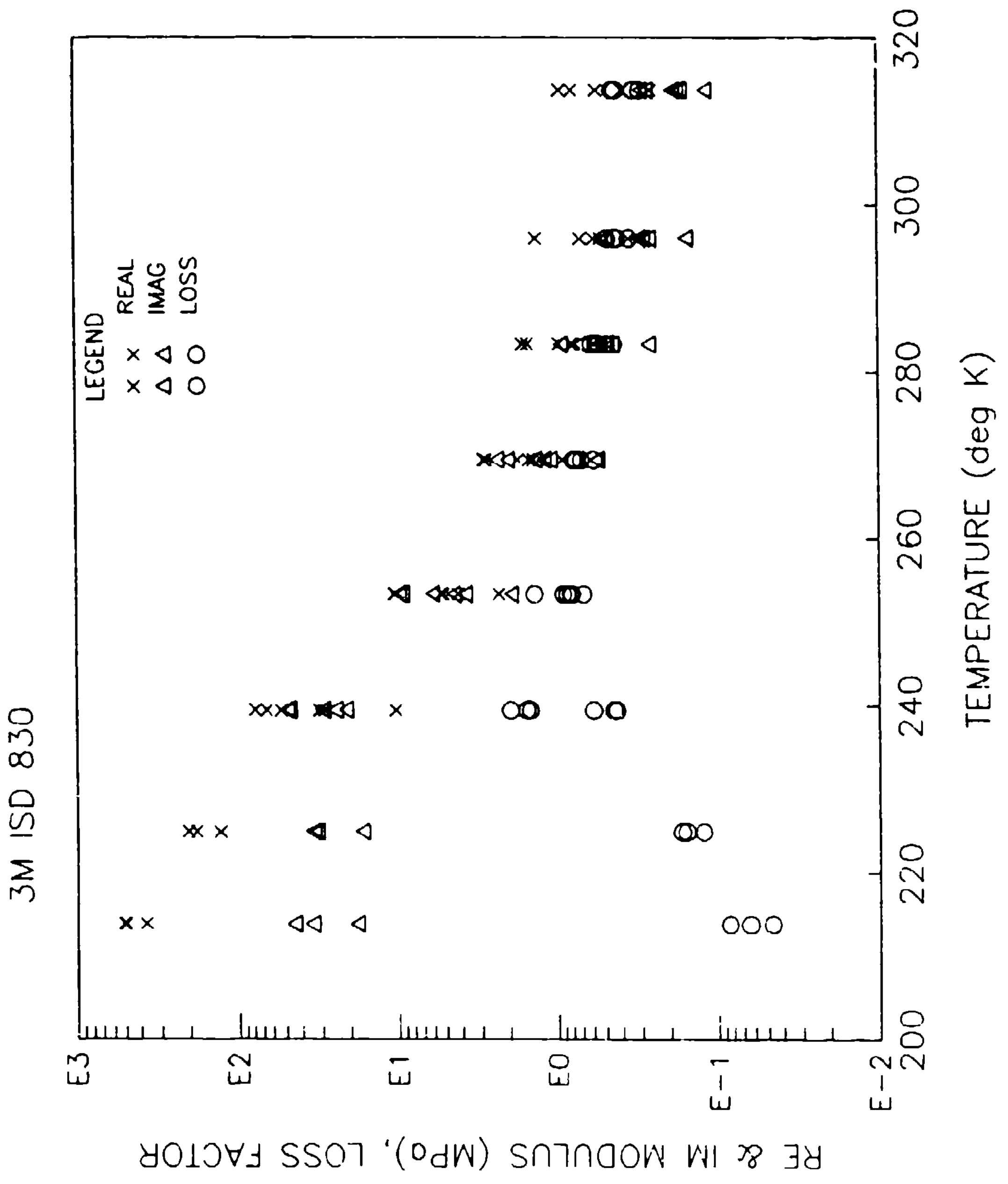
3M ISD 830

SHEAR

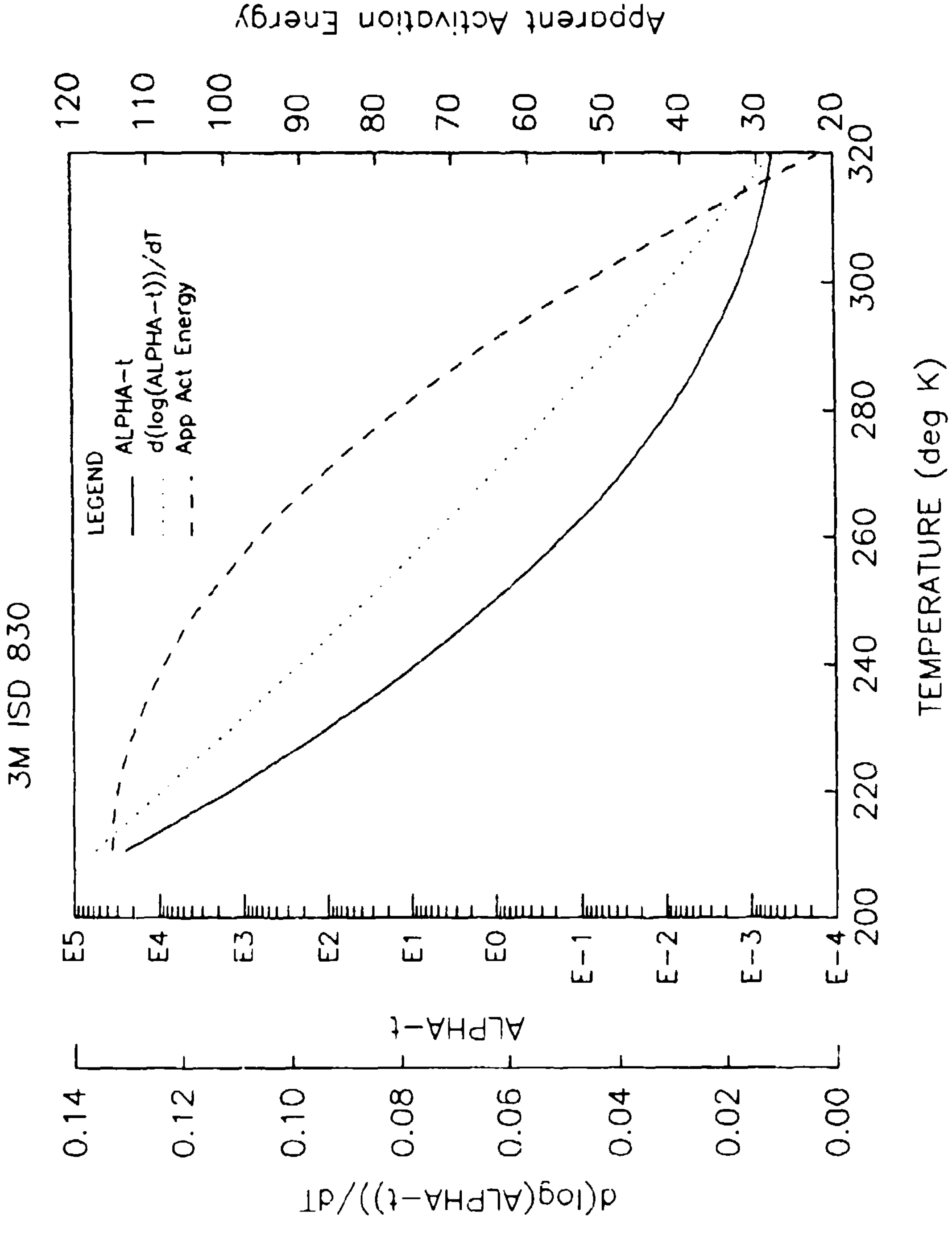



3M ISD 830
FREQUENCY (Hz)
E4
E3
E2
200
220
240
260
280
300
320
TEMPERATURE (deg K)
-80
-60
-40
-20
0
20
40
60
80
100
TEMPERATURE (deg F)


3M ISD 830
LOSS FACTOR
E1
E0
E-1
E-2
E-1
E0
E1
E2
E3
MAGNITUDE MODULUS (MPa)



3M ISD 830
RE & IM MODULUS (MPa), LOSS FACTOR
TEMPERATURE (deg K)
LEGEND
REAL
IMAG
LOSS
E3
E2
E1
E0
E−1
E−2
200
220
240
260
280
300
320



3M ISD 830
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
200
220
240
260
280
300
320
ALPHA-t
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
d(log(ALPHA-t))/dT
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Apparent Activation Energy
120
110
100
90
80
70
60
50
40
30
20

3M ISD 830 SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	250.0	210.0	320.0	0.3600E-01	0.1366	0.1100E-01

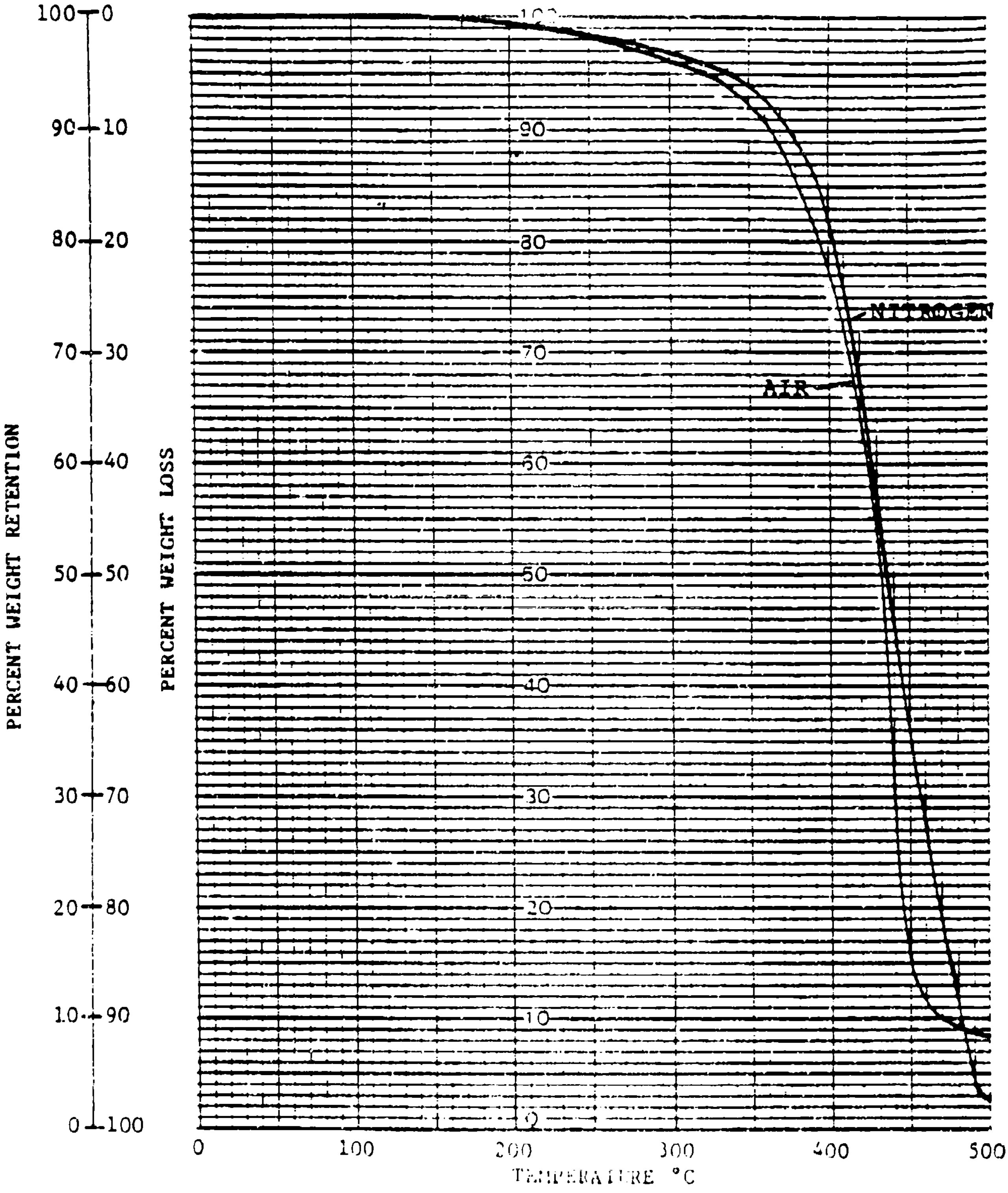
COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.3660	865.0	0.2700E+07	0.5600	3.100	0.7800E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
295.9	268.1	0.3510	0.4320	0.1516
295.9	1383.	0.5761	0.4792	0.2761
295.9	2212.	0.7019	0.4192	0.2942
295.9	3321.	1.338	0.3537	0.4733
283.2	280.1	0.5266	0.4885	0.2572
283.2	734.1	0.7812	0.5559	0.4343
283.2	1376.	0.8[illegible]3	0.6012	0.4841
283.2	2241.	0.9660	0.5363	0.5181
283.2	3357.	1.529	0.4439	0.6787
283.2	4640.	1.647	0.3496	0.9052
269.3	301.1	0.9170	0.5875	0.5387
269.3	782.1	1.407	0.7541	1.061
269.3	1434.	1.502	0.7687	1.155
269.3	2311.	1.763	0.7515	1.325
269.3	3454.	2.786	0.7012	1.954
269.3	4750.	2.888	0.7924	2.288
253.2	351.1	2.328	0.8043	1.872
253.2	959.1	4.198	1.396	5.860
253.2	1667.	5.364	0.6836	3.667
253.2	2556.	5.192	0.8249	4.283
253.2	3972.	10.51	0.8639	9.080
253.2	5296.	10.43	0.9159	9.553
239.3	478.0	10.41	1.975	20.56
239.3	1329.	29.00	1.563	45.33
239.3	2423.	31.09	1.481	46.04
239.3	3718.	53.52	0.4482	23.99
239.3	5596.	78.95	0.5980	47.21
239.3	7107.	66.51	0.4297	28.58
224.8	1436.	129.4	0.1266	16.38
224.8	2718.	182.0	0.1728	31.45
213.7	2779.	504.5	0.8571E-01	43.24
213.7	6621.	519.5	0.6451E-01	33.51
213.7	8860.	374.1	0.4738E-01	17.72
313.7	260.1	0.2570	0.4456	0.1145
313.7	697.1	0.3891	0.4429	0.1723
313.7	1332.	0.3832	0.4261	0.1633
313.7	2190.	0.5546	0.3289	0.1824
313.7	3268.	0.7922	0.3329	0.2637
313.7	4584.	0.9481	0.3018	0.2861
295.9	712.1	0.5302	0.4791	0.2540

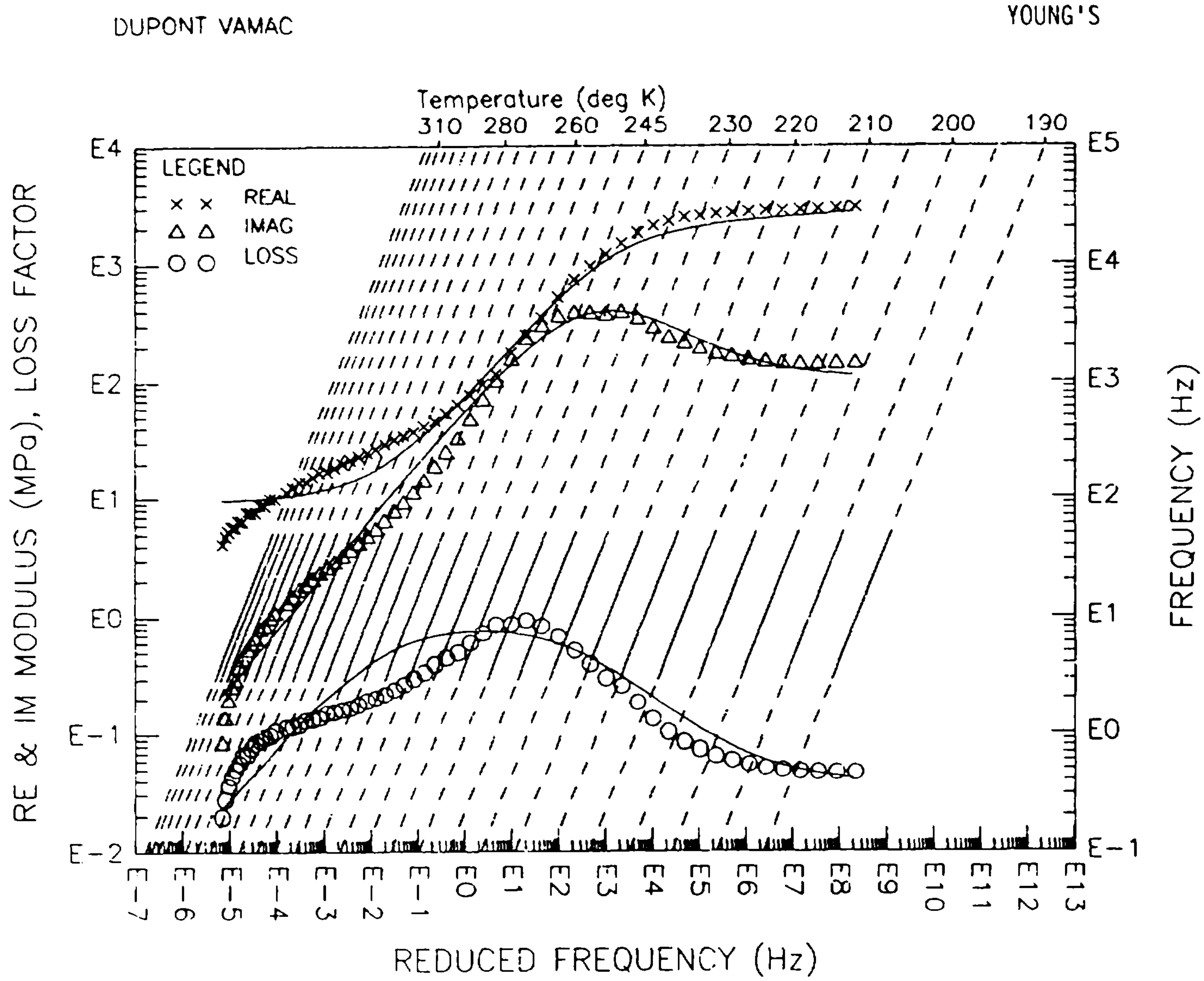
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
224.8	4294.	204.7	0.1620	33.16

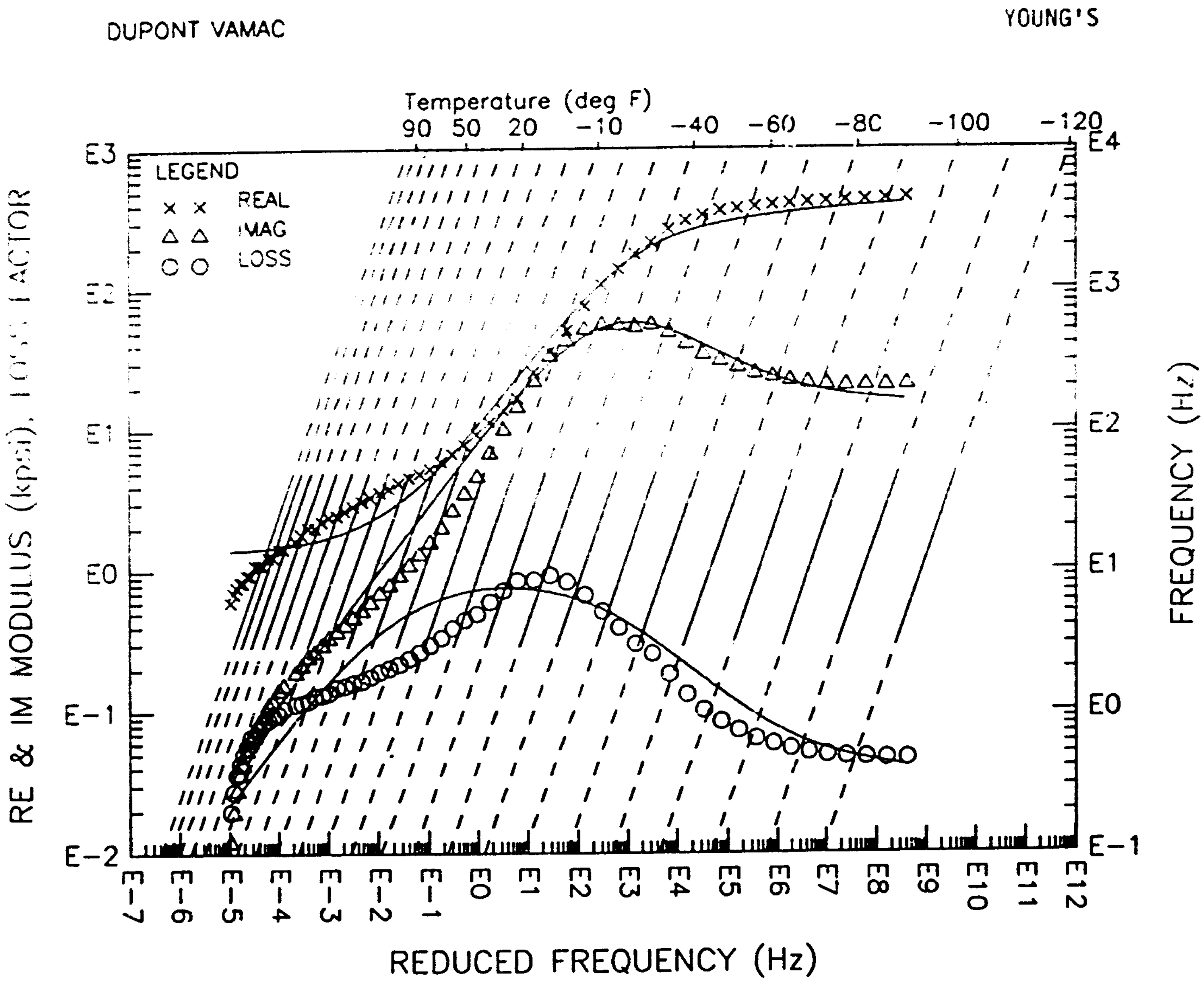

PERCENT WEIGHT RETENTION
PERCENT WEIGHT LOSS
100 0
90 10
80 20
70 30
60 40
50 50
40 60
30 70
20 80
10 90
0 100
NITROGEN
AIR
0
100
200
300
400
500
TEMPERATURE °C

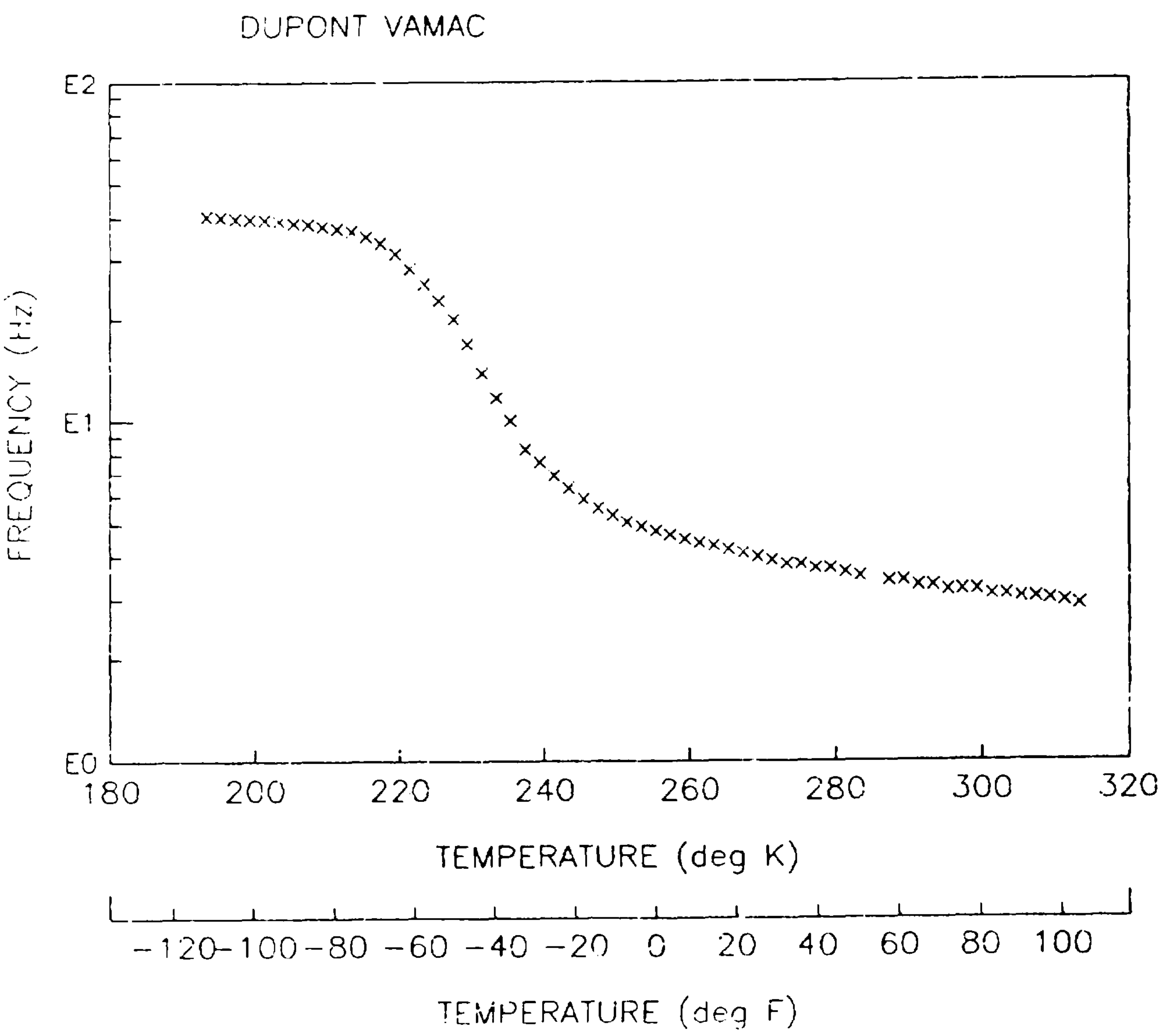
[illegible]

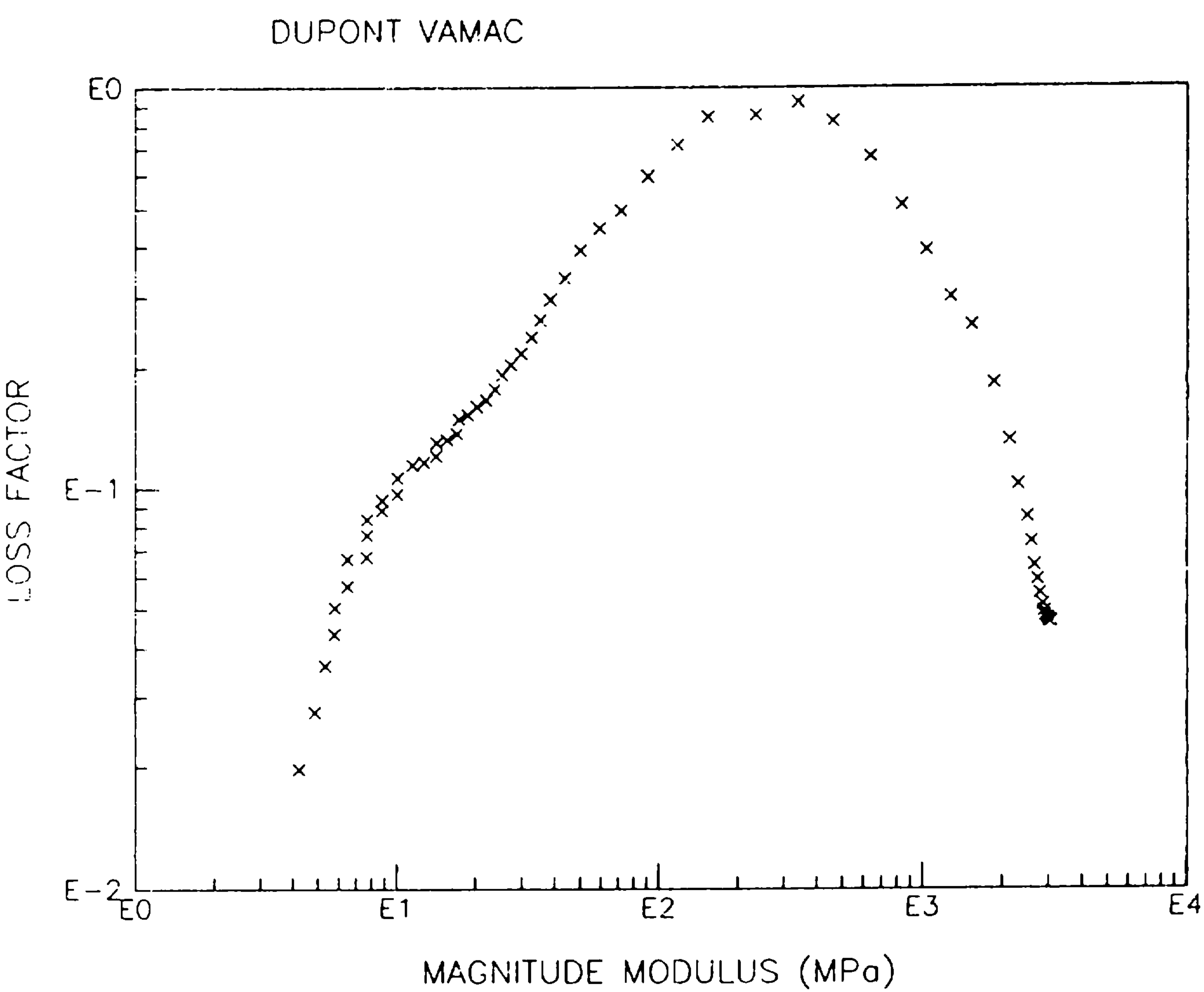
DUPONT VAMAC YOUNG'S

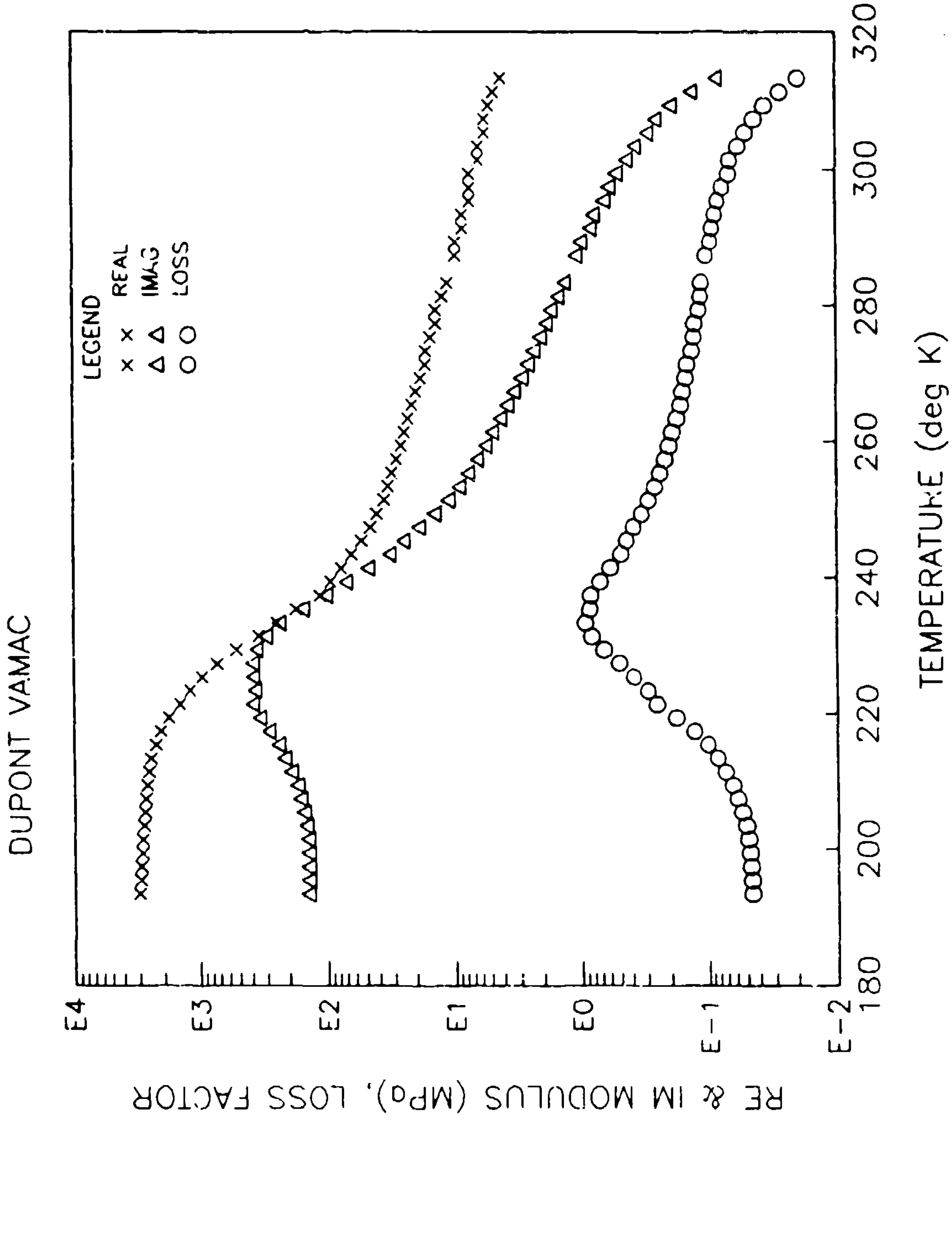
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.4097E-01	0.5276	0.7538	0.5276	0.2266E-01
MODULUS	MPA	2742.	667.0	98.72	22.94	9.587
	PSI	0.3977E+06	0.9674E+05	0.1432E+05	3327.	1390.
10.HZ	DEG K		225.0	241.0	258.0	
	DEG C		-68.15	-52.15	-35.15	
	DEG F		-90.67	-61.87	-31.27	
100.HZ	DEG K		232.0	250.0	270.0	
	DEG C		-61.15	-43.15	-23.15	
	DEG F		-78.07	-45.67	-9.670	
1000.HZ	DEG K		241.0	260.0	285.0	
	DEG C		-52.15	-33.15	-8.150	
	DEG F		-61.87	-27.67	17.33	


DUPONT VAMAC
YOUNG'S
Temperature (deg K)
310 280 260 245 230 220 210 200 190
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
E−1
E−2
FREQUENCY (Hz)
E5
E4
E3
E2
E1
E0
E−1
REDUCED FREQUENCY (Hz)
E−7 E−6 E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13

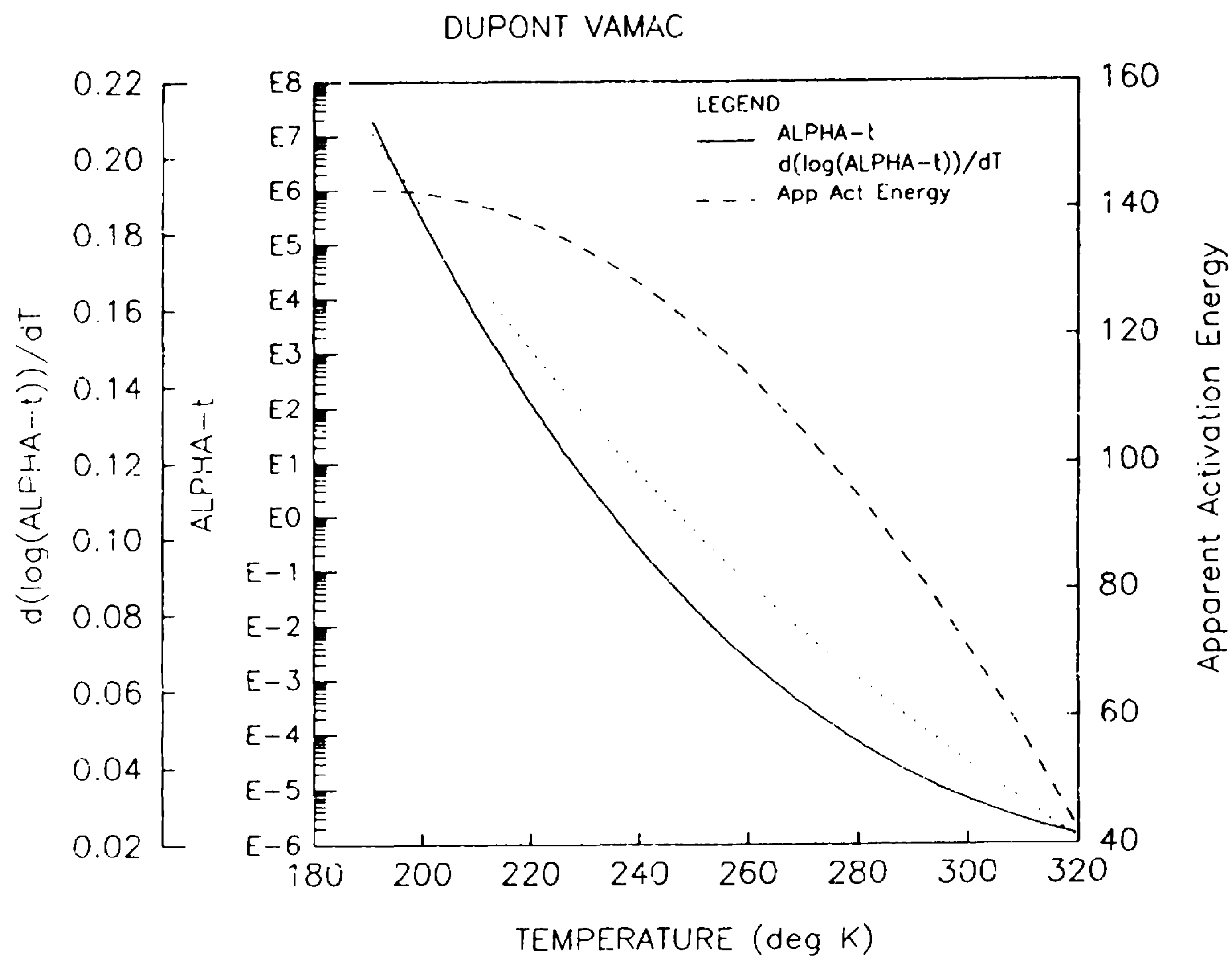

DUPONT VAMAC
YOUNG'S
Temperature (deg F)
90 50 20 -10 -40 -60 -8C -100 -120
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
E3
E2
E1
E0
E-1
E-2
E4
E3
E2
E1
E0
E-1
E-7 E-6 E-5 E-4 E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12
REDUCED FREQUENCY (Hz)
FREQUENCY (Hz)


DUPONT VAMAC
FREQUENCY (Hz)
E2
E1
E0
180
200
220
240
260
280
300
320
TEMPERATURE (deg K)
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
TEMPERATURE (deg F)


DUPONT VAMAC
LOSS FACTOR
E0
E-1
E-2
E0
E1
E2
E3
E4
MAGNITUDE MODULUS (MPa)



DUPONT VAMAC
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
E−1
E−2
180
200
220
240
260
280
300
320
TEMPERATURE (deg K)



DUPONT VAMAC
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
ALPHA-t
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
E-5
E-6
Apparent Activation Energy
160
140
120
100
80
60
40
180
200
220
240
260
280
300
320
TEMPERATURE (deg K)

DUPONT VAMAC YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	235.0	190.0	320.0	0.1242	0.2076	0.2147E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	9.350	5000.	4810.	0.4725	1.478	0.5465E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
193.2	40.30	3030.	0.4630E-01	140.3
195.2	40.00	2980.	0.4640E-01	138.3
197.2	39.70	2940.	0.4710E-01	138.5
199.2	39.40	2890.	0.4780E-01	138.1
201.2	39.20	2860.	0.4910E-01	140.4
303.2	39.00	2830.	0.5120E-01	144.9
205.2	38.50	2760.	0.5470E-01	151.0
207.2	38.10	2710.	0.5920E-01	160.4
209.2	37.60	2630.	0.6430E-01	169.1
211.2	37.00	2560.	0.7350E-01	188.2
213.2	36.40	2470.	0.8480E-01	209.5
215.2	35.00	2280.	0.1020	232.6
217.2	33.60	2100.	0.1320	277.2
219.2	31.30	1820.	0.1830	333.1
221.2	28.30	1480.	0.2560	378.9
223.2	25.50	1210.	0.3010	364.2
225.2	22.80	957.0	0.3930	376.1
227.2	20.00	737.0	0.5120	377.3
229.2	16.90	523.0	0.6710	350.9
231.2	13.90	350.0	0.8300	290.5
233.2	11.70	246.0	0.9240	227.3
235.2	10.00	176.0	0.8600	151.4
237.2	8.250	116.0	0.8500	98.60
239.2	7.540	94.90	0.7190	68.23
241.2	6.890	77.40	0.5990	46.36
243.2	6.340	63.80	0.4940	31.52
245.2	5.900	53.70	0.4460	23.95
247.2	5.550	46.20	0.3920	18.11
249.2	5.300	41.10	0.3350	13.77
251.2	5.060	36.50	0.2970	10.84
253.2	4.910	33.70	0.2640	8.897
255.2	4.780	31.30	0.2390	7.481
257.2	4.640	28.80	0.2180	6.278
259.2	4.490	26.30	0.2040	5.365
261.2	4.390	24.60	0.1920	4.723
263.2	4.290	23.00	0.1770	4.071
265.2	4.190	21.40	0.1660	3.552
267.2	4.090	19.80	0.1600	3.168
269.2	3.990	18.30	0.1530	2.800
271.2	3.890	16.90	0.1490	2.518

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
273.2	3.780	16.60	0.1370	2.274
275.2	3.780	15.30	0.1320	2.020
277.2	3.680	13.90	0.1300	1.807
279.2	3.680	13.90	0.1200	1.668
281.2	3.580	12.50	0.1160	1.450
283.2	3.490	11.30	0.1140	1.288
287.2	3.380	9.920	0.1060	1.052
289.2	3.380	9.920	0.9700E-01	0.9622
291.2	3.280	8.670	0.9370E-01	0.8124
293.2	3.280	8.670	0.8840E-01	0.7664
295.2	3.190	7.580	0.8370E-01	0.6344
297.2	3.190	7.560	0.7640E-01	0.5791
299.2	3.190	7.580	0.6740E-01	0.5109
301.2	3.090	6.410	0.6670E-01	0.4275
303.2	3.090	6.410	0.5710E-01	0.3660
305.2	3.030	5.720	0.5040E-01	0.2883
307.2	3 030	5.720	0.4320E-01	0.2471
309.2	2.990	5.270	0.3610E-01	0.1902
311.2	2.950	4.820	0.2750E-01	0.1326
313.2	2.890	4.170	0.1980E-01	0.8257E-01

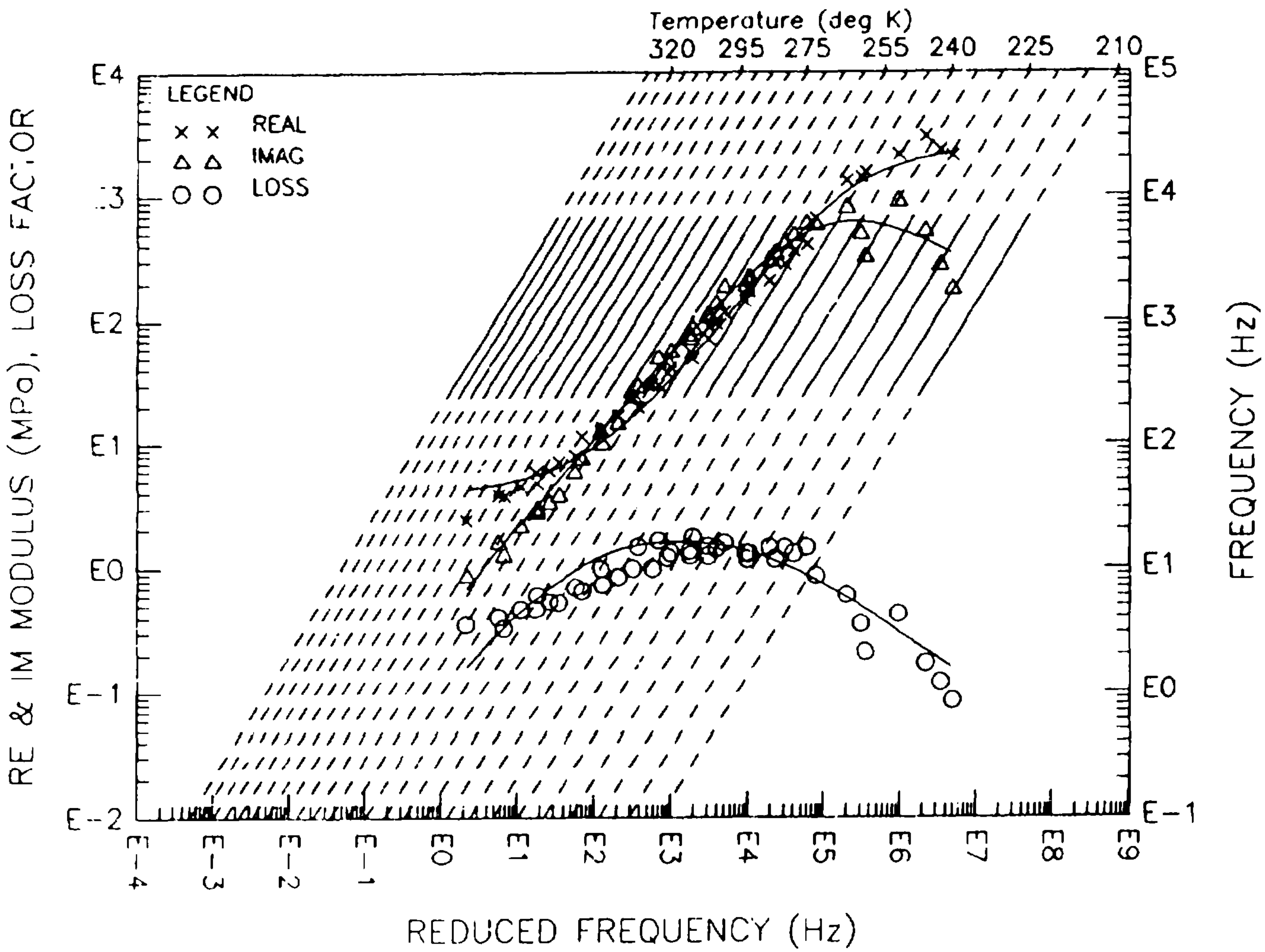
UDRI BUTYL 1066, 75 PHR 6894, 2 PHR CB

SHEAR

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1550	1.125	1.607	1.125	0.1612
MODULUS	MPA	2181.	356.7	37.44	9.084	4 332
	PSI	0.3163E+06	0.5174E+05	5431.	1317.	628.2
10.HZ	DEG K		215.0	234.0	252.0	
	DEG C		-78.15	-59.15	-41.15	
	DEG F		-108.7	-74.47	-42.07	
100.HZ	DEG K		229.0	250.0	271.0	
	DEG C		-64.15	-43.15	-22.15	
	DEG F		-83.47	-45.67	-7.870	
1000.HZ	DEG K		244.0	268.0	293.0	
	DEG C		-49.15	-25.15	-.1500	
	DEG F		-56.47	-13.27	31.73	

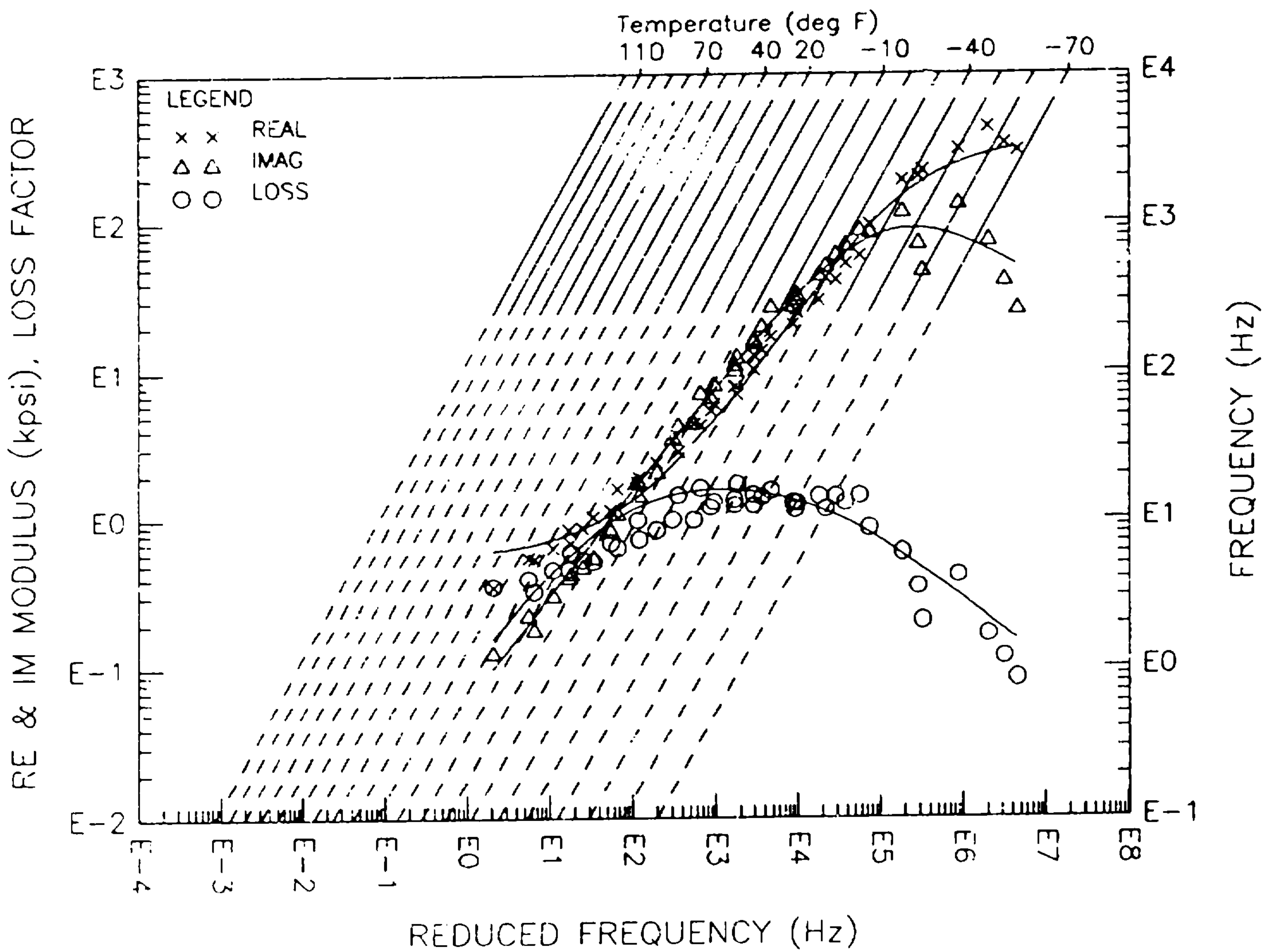
UDRI BUTYL 1066, 75 PHR 6894, 2 PHR CB

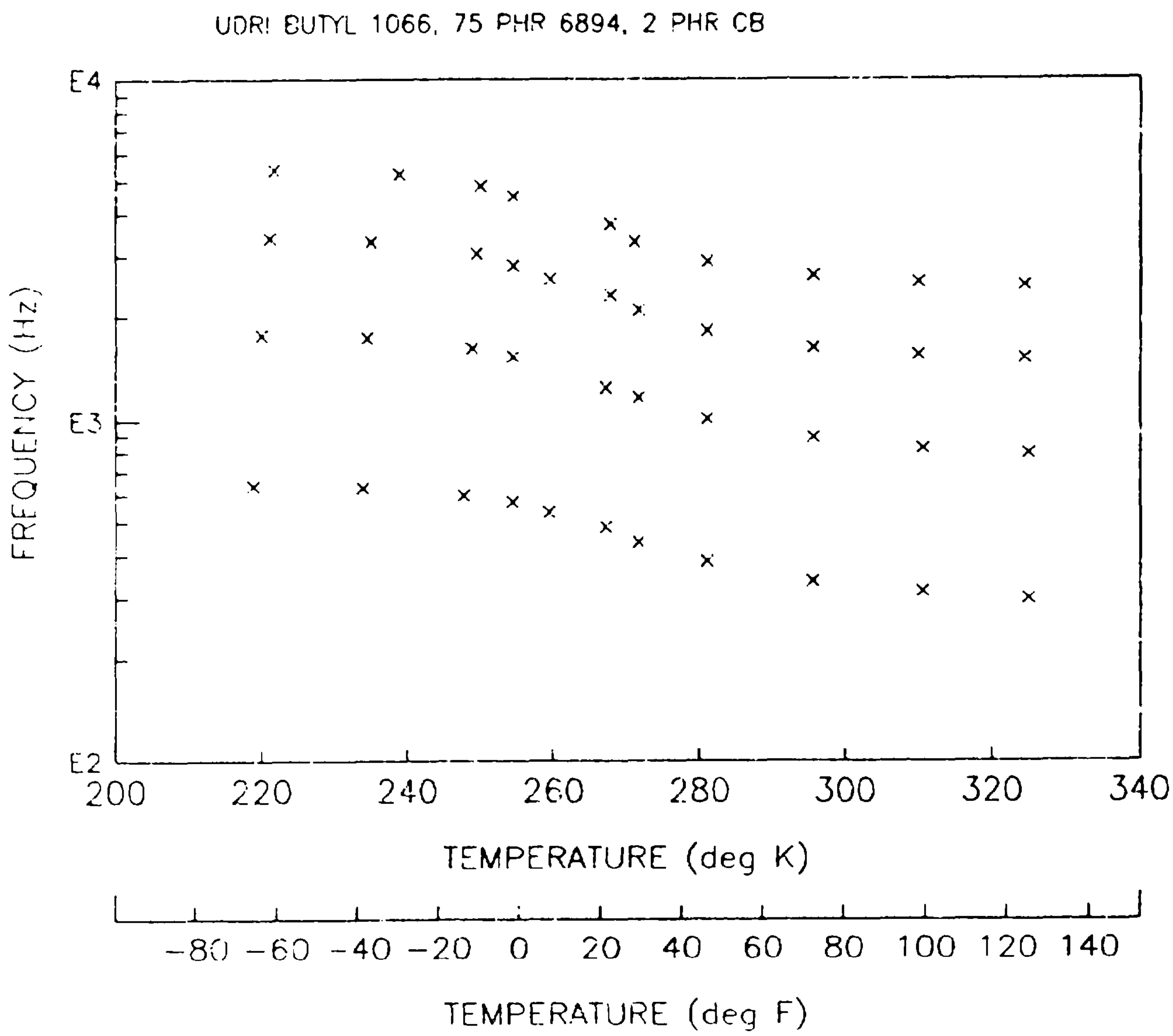
SHEAR

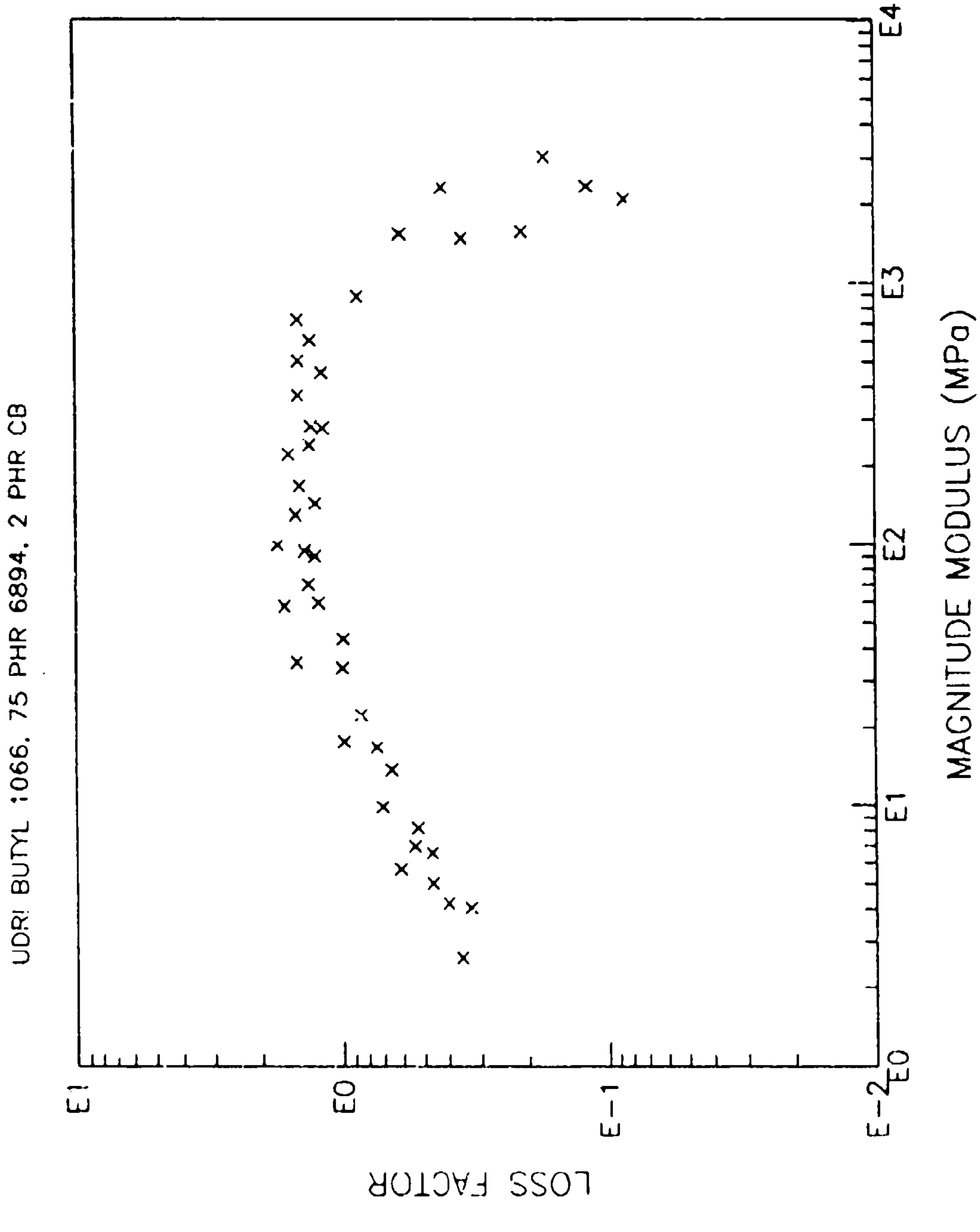


UDRI BUTYL 1066, 75 PHR 6894, 2 PHR CB

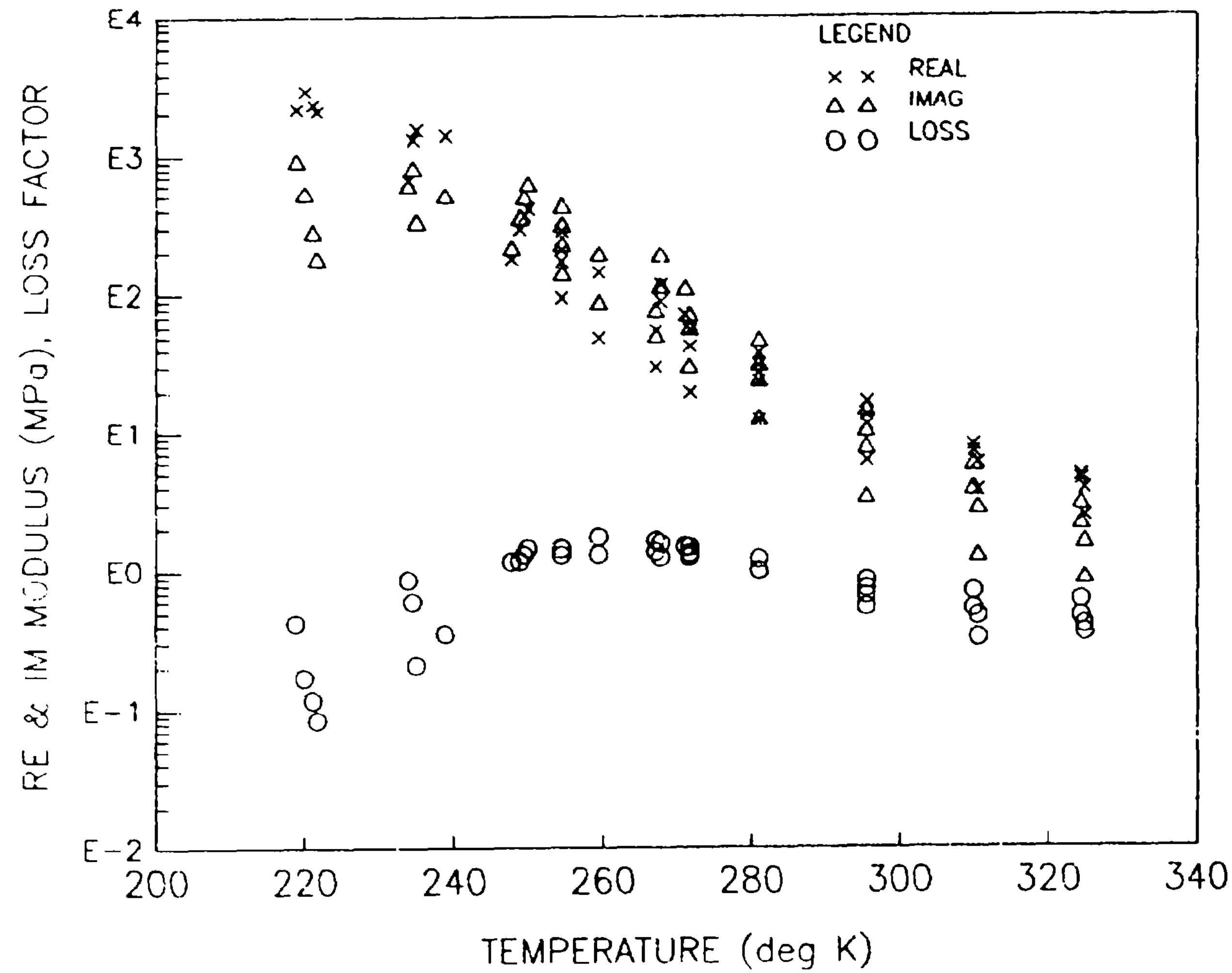
SHEAR

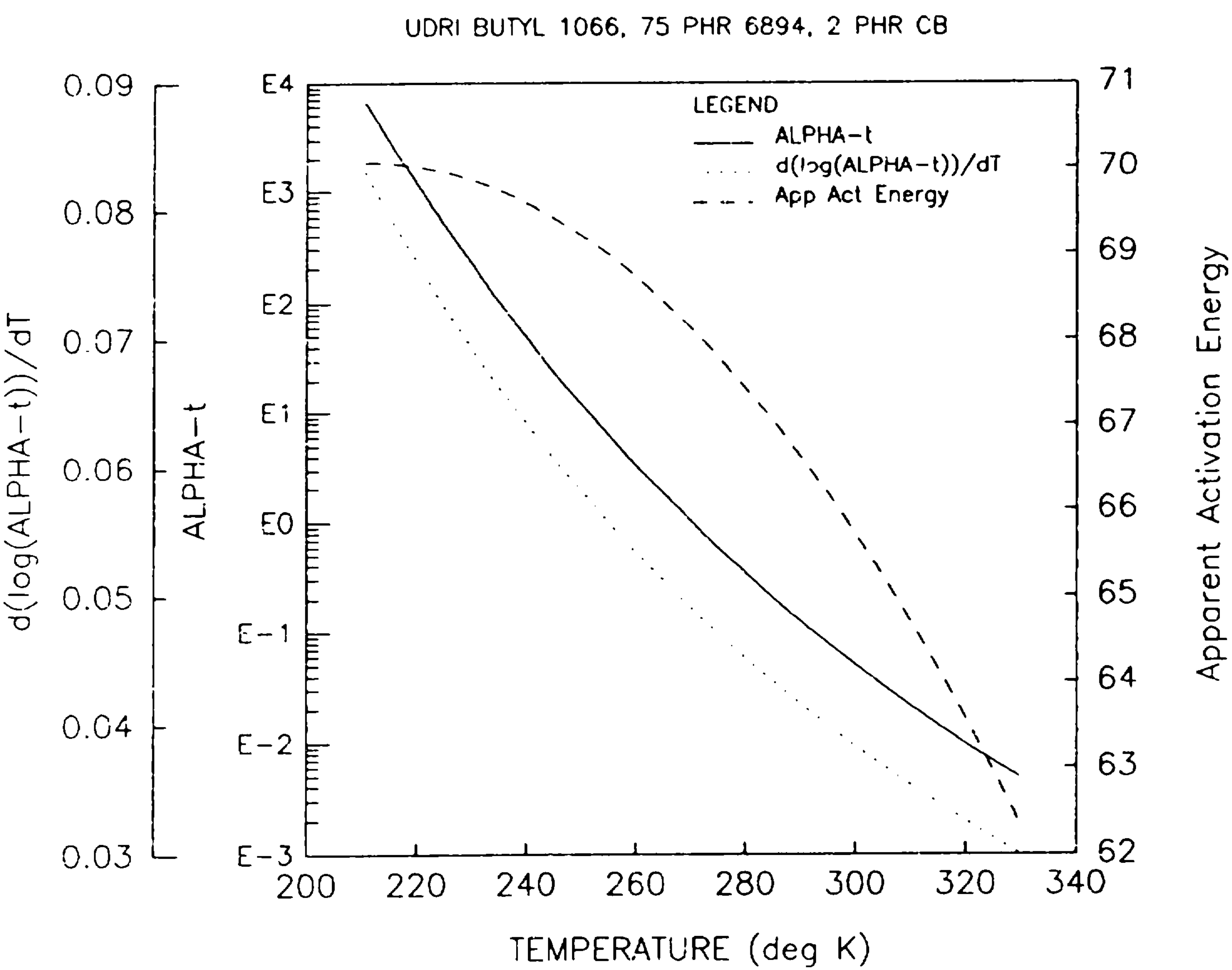



UDRI BUTYL 1066, 75 PHR 6894, 2 PHR CB
FREQUENCY (Hz)
E4
E3
E2
200
220
240
260
280
300
320
340
TEMPERATURE (deg K)
-80
-60
-40
-20
0
20
40
60
80
100
120
140
TEMPERATURE (deg F)


UDRI BUTYL 1066, 75 PHR 6894, 2 PHR CB
LOSS FACTOR
MAGNITUDE MODULUS (MPa)
E1
E0
E-1
E-2
E0
E1
E2
E3
E4

UDRI BUTYL 1066, 75 PHR 6894, 2 PHR CB




UDRI BUTYL 1066, 75 PHR 6894, 2 PHR CB
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.09
0.08
0.07
0.06
0.05
0.04
0.03
ALPHA-t
E4
E3
E2
E1
E0
E-1
E-2
E-3
Apparent Activation Energy
71
70
69
68
67
66
65
64
63
62
TEMPERATURE (deg K)
200
220
240
260
280
300
320
340

UDRI BUTYL 1066, 75 PHR 6894, 2 PHR CB SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	270.0	210.0	330.0	0.4900E-01	0.8331E-01	0.3000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	4.000	2800.	0.1800E+06	0.7200	0.6500	0.3000

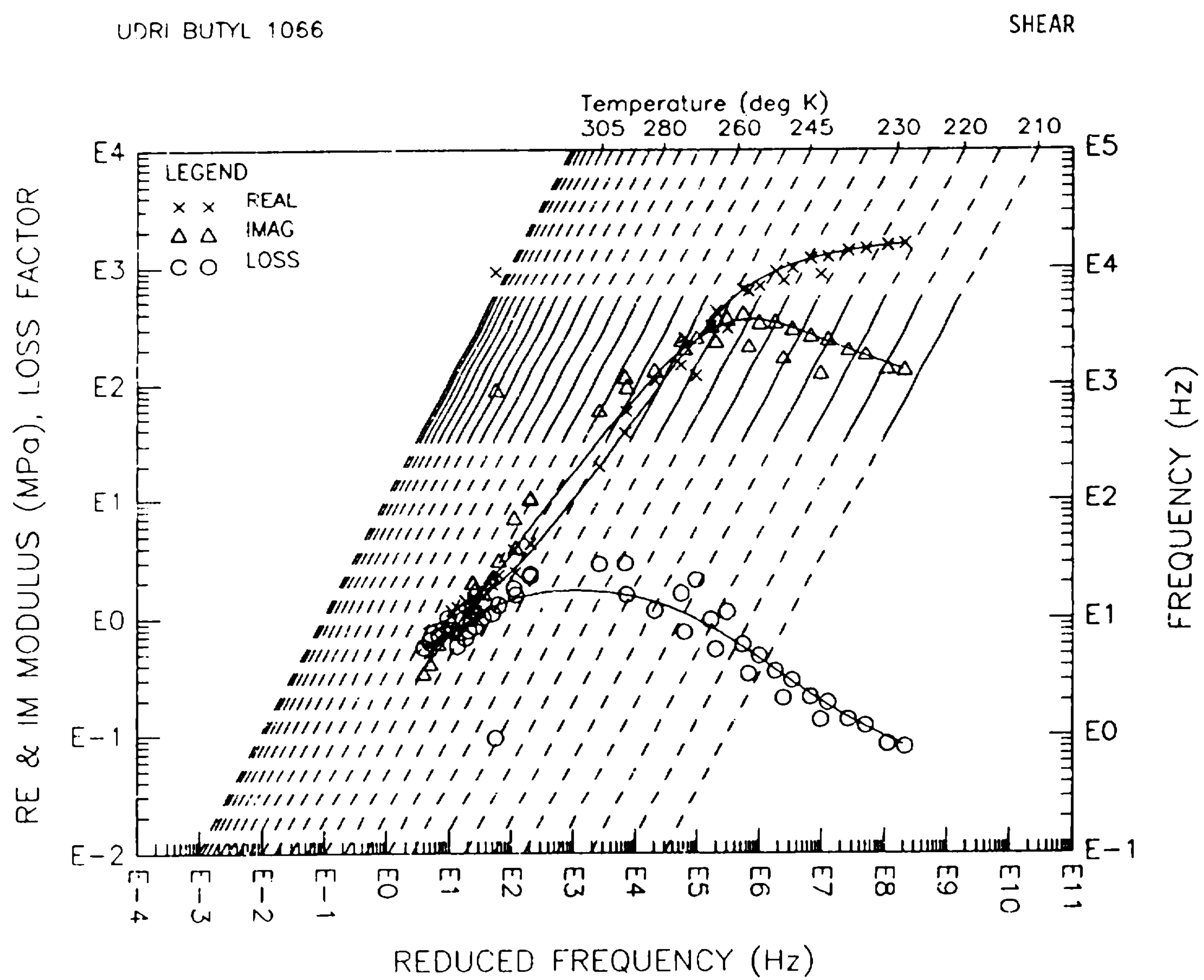
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

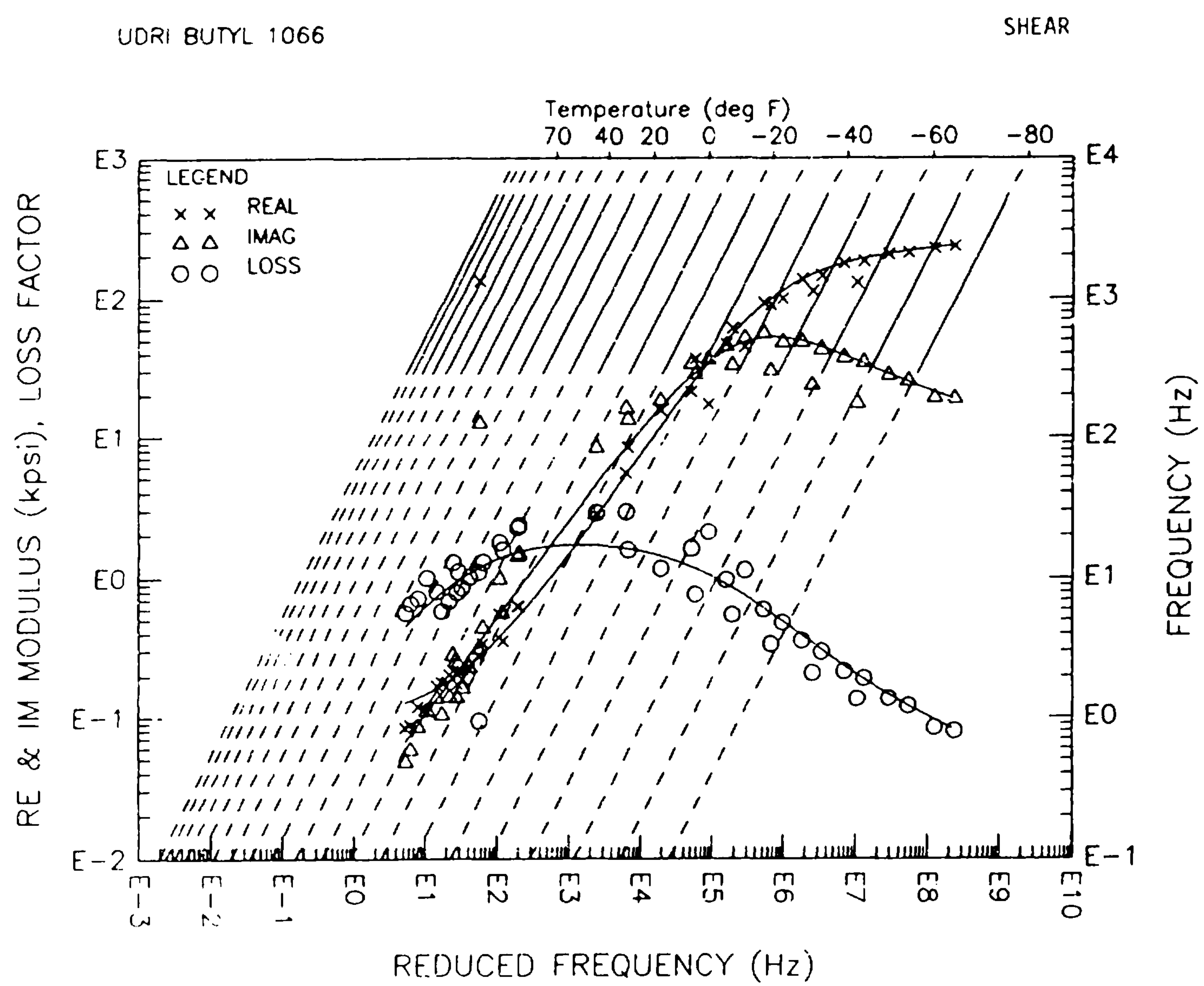
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
295.4	336.8	6.041	0.5417	3.272
295.4	888.6	11.33	0.6551	7.422
295.4	1632.	13.35	0.7397	9.875
295.4	2640.	16.75	0.8482	14.21
218.7	642.2	2120.	0.4219	894.4
219.8	1780.	2971.	0.1702	505.7
220.9	3385.	2308.	0.1187	274.0
221.5	5417.	2064.	0.8515E-01	175.7
233.7	630.8	659.9	0.8703	574.3
234.3	1744.	1303.	0.6041	787.1
234.8	3304.	1523.	0.2095	319.1
235.7	5254.	1383.	0.3508	485.2
247.6	599.7	178.6	1.167	208.4
248.7	1623.	290.6	1.177	342.0
249.3	3060.	363.9	1.299	472.7
249.8	4846.	406.0	1.451	589.1
254.3	573.8	94.94	1.422	135.0
254.3	2825.	208.2	1.444	300.6
254.3	1531.	170.7	1.294	220.9
254.3	4517.	283.4	1.442	408.7
259.3	534.8	48.75	1.740	84.82
259.3	2581.	143.5	1.305	187.3
267.0	482.0	29.68	1.640	48.68
267.0	1240.	54.91	1.364	74.90
267.6	2302.	88.39	1.245	110.0
267.6	3718.	117.1	1.574	184.3
271.5	435.3	19.66	1.466	28.82
271.5	1164.	41.78	1.319	55.11
271.5	2077.	55.53	1.251	69.47
270.9	3299.	71.50	1.476	105.5
280.9	384.4	12.40	0.9880	12.25
280.9	1013.	23.49	0.9980	23.44
280.9	1826.	30.32	0.9935	30.12
280.9	2904.	37.36	1.214	45.36
310.4	315.1	3.792	0.3276	1.242
310.4	824.1	5.891	0.4670	2.751
309.8	1551.	7.143	0.5294	3.782
309.8	2520.	7.957	0.7071	5.626
324.8	299.9	2.420	0.3548	0.8586
324.8	795.9	3.864	0.4012	1.550

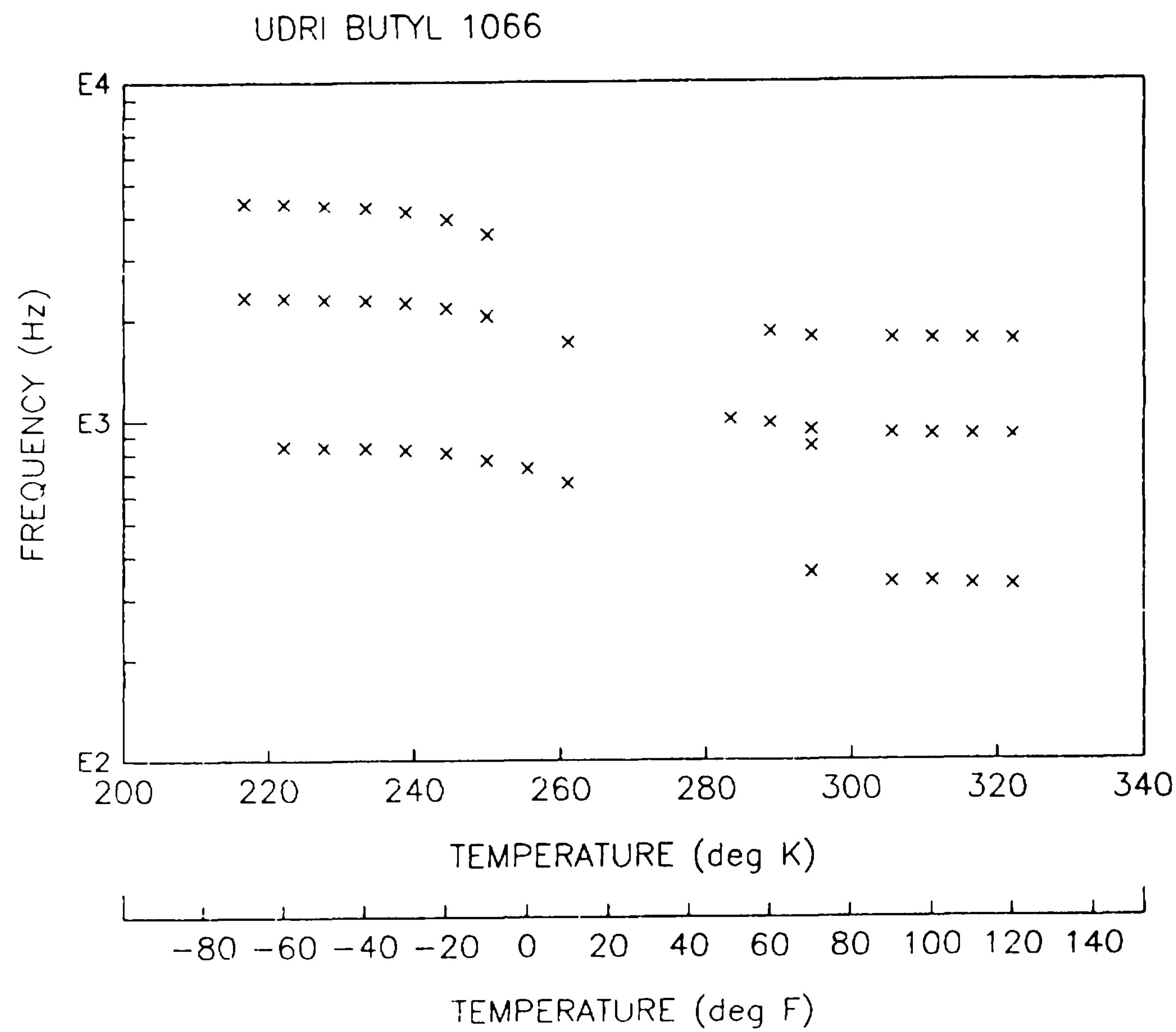
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
324.3	1512.	4.500	0.4640	2.088
324.3	2470.	4.803	0.6101	2.930

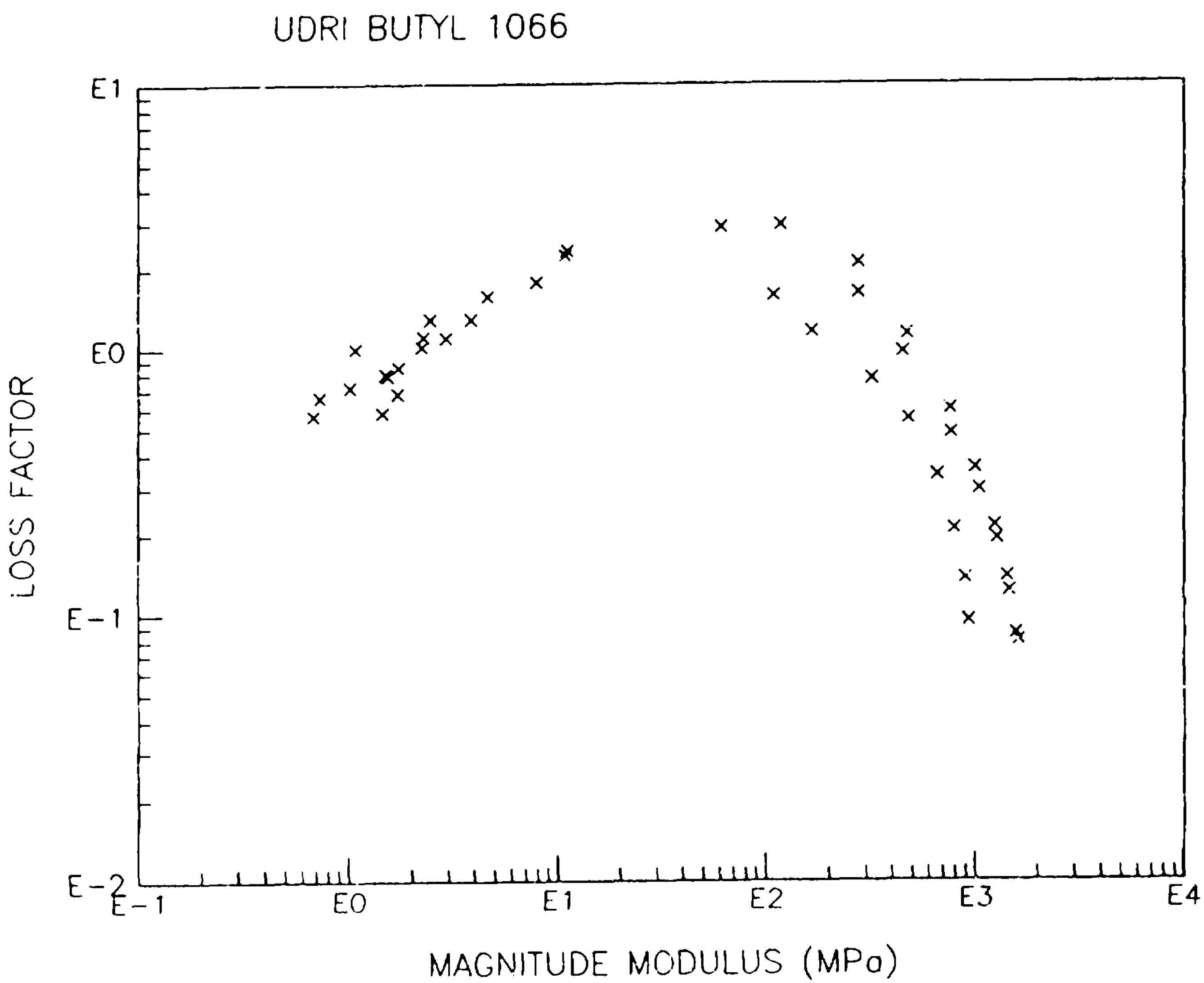
UDRI BUTYL 1066 SHEAR

		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.8176E-01	1.169	1.670	1.169	0.4498
MODULUS	MPA	1603.	170.9	11.52	1.714	0.8314
	PSI	0.2326E+06	0.2479E+05	1670.	248.6	120.6
10.HZ	DEG K		225.0	242.0	260.0	
	DEG C		-68.15	-51.15	-33.15	
	DEG F		-90.67	-60.07	-27.67	
100.HZ	DEG K		235.0	255.0	277.0	
	DEG C		-58.15	-38.15	-16.15	
	DEG F		-72.67	-36.67	2.930	
1000.HZ	DEG K		246.0	270.0	300.0	
	DEG C		-47.15	-23.15	6.850	
	DEG F		-52.87	-9.670	44.33	

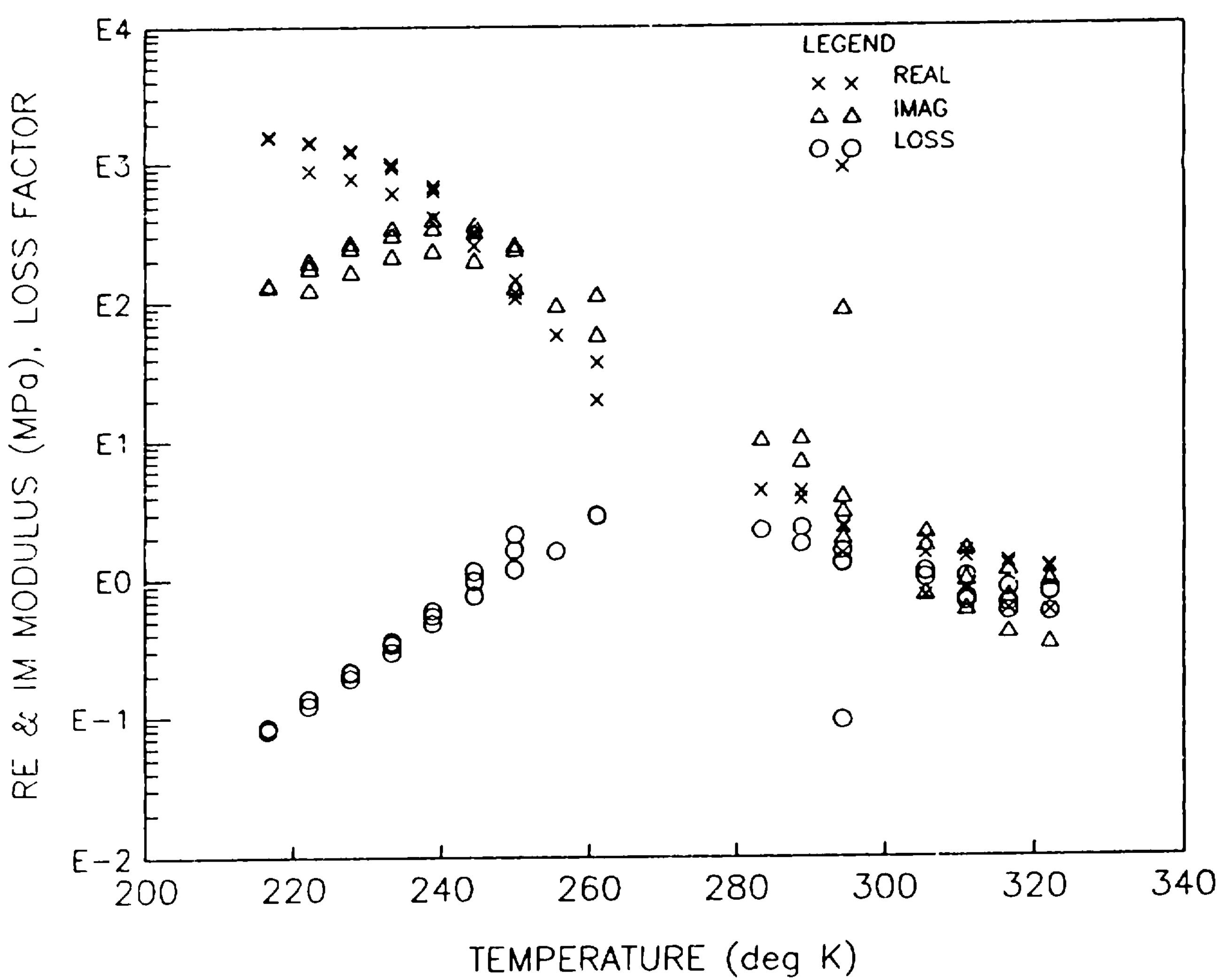

UDRI BUTYL 1066
SHEAR
Temperature (deg K)
305 280 260 245 230 220 210
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)
E4 E3 E2 E1 E0 E−1 E−2
E5 E4 E3 E2 E1 E0 E−1
E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11


UDRI BUTYL 1066
SHEAR
Temperature (deg F)
70 40 20 0 −20 −40 −60 −80
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
E3 E2 E1 E0 E−1 E−2
RE & IM MODULUS (kpsi), LOSS FACTOR
E4 E3 E2 E1 E0 E−1
FREQUENCY (Hz)
E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10
REDUCED FREQUENCY (Hz)

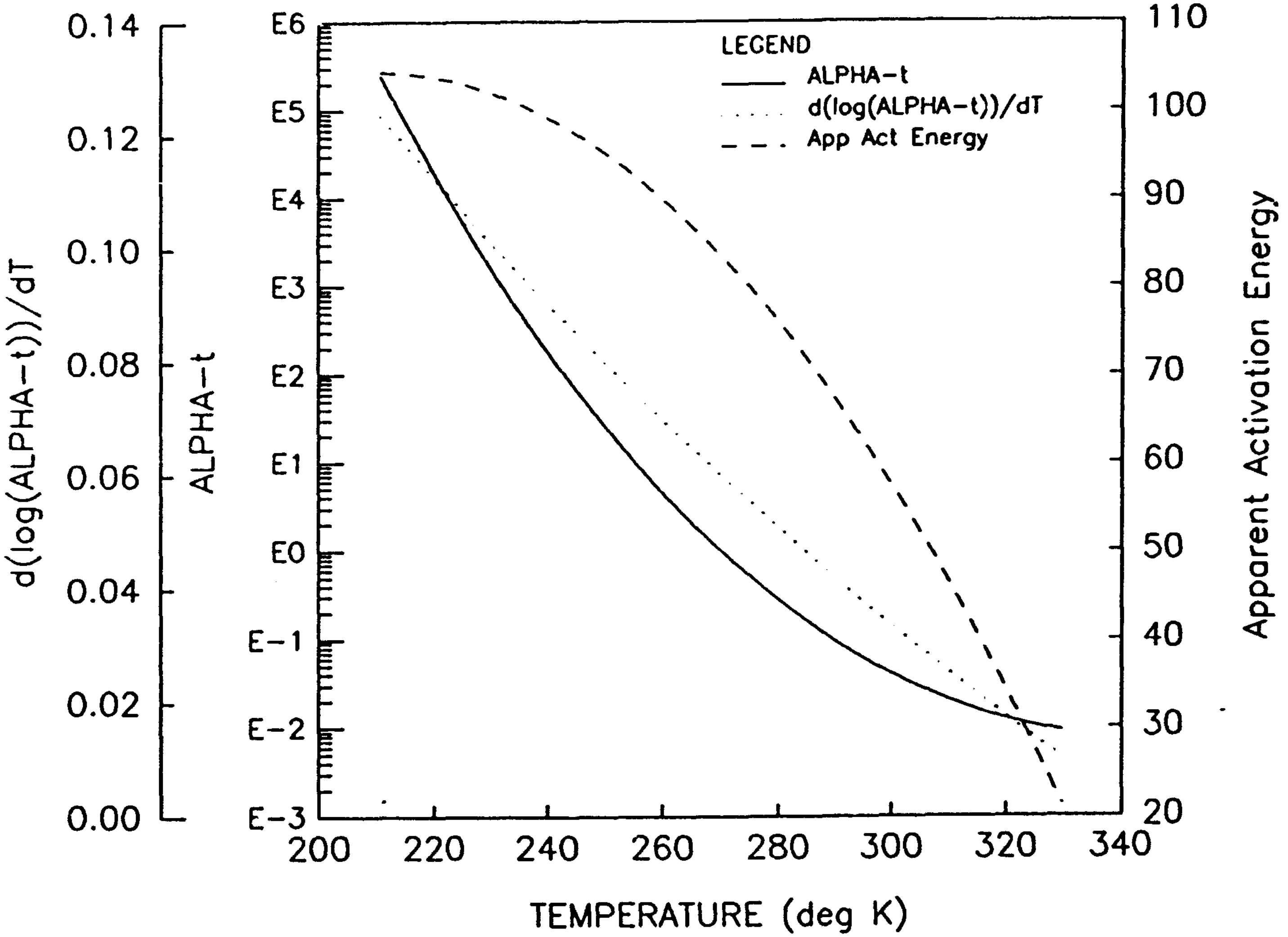

UDRI BUTYL 1066
FREQUENCY (Hz)
E4
E3
E2
200 220 240 260 280 300 320 340
TEMPERATURE (deg K)
-80 -60 -40 -20 0 20 40 60 80 100 120 140
TEMPERATURE (deg F)


UDRI BUTYL 1066
LOSS FACTOR
E1
E0
E-1
E-2
E-1
E0
E1
E2
E3
E4
MAGNITUDE MODULUS (MPa)

UDRI BUTYL 1066



UDRI BUTYL 1066



UDRI BUTYL 1066 SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	270.0	210.0	330.0	0.6000E-01	0.1240	0.1000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.6400	2038.	0.7000E+06	0.7000	0.8821	0.2100

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
294.3	842.4	918.4	0.9439E-01	86.69
216.5	2320.	1549.	0.8428E-01	130.5
216.5	4399.	1602.	0.7983E-01	127.9
222.0	840.3	881.9	0.1354	119.4
222.0	2308.	1400.	0.1372	192.1
222.0	4[illegible]66.	1440.	0.1210	174.2
227.6	836.5	773.6	0.2087	161.5
227.6	2293.	1202.	0.2140	257.2
227.6	4320.	1242.	0.1909	237.1
233.2	830.0	617.7	0.3356	207.3
233.2	2269.	935.0	0.3554	332.3
233.2	4251	990.8	0.2958	293.1
238.7	820.1	416.5	0.5450	227.0
238.7	2236.	643.8	0.5966	384.1
238.7	4135.	685.6	0.4806	329.5
244.3	804.5	253.3	0.7658	194.0
244.3	2156.	320.2	0.9711	310.9
244.3	3921.	309.3	1.133	350.4
249.8	765.2	107.1	1.165	124.8
249.8	2048.	144.7	1.608	232.7
249.8	3647.	117.8	2.105	248.0
255.4	727.7	58.08	1.576	91.53
260.9	657.6	19.77	2.895	57.23
260.9	1710.	37.52	2.940	110.3
283.2	1012.	4.349	2.260	9.829
288.7	986.1	3.821	1.776	6.786
288.7	1834.	4.302	2.354	10.13
294.3	359.7	1.496	1.287	1.925
294.3	940.3	2.339	1.295	3.029
294.3	1776.	2.444	1.576	3.852
305.4	336.5	0.7536	1.006	0.7581
305.4	915.1	1.498	1.115	1.670
305.4	1756.	1.932	1.103	2.131
310.9	337.1	0.8191	.7174	0.5876
310.9	910.6	1.403	0.6809	0.9553
310.9	1743.	1.548	1.019	1.577
316.5	330.5	0.6026	0.6607	0.3981
316.5	905.0	1.234	0.5798	0.7155
316.5	1734.	1.302	0.8527	1.[illegible]10
322.0	329.3	0.5836	0.5647	0.3[illegible]96

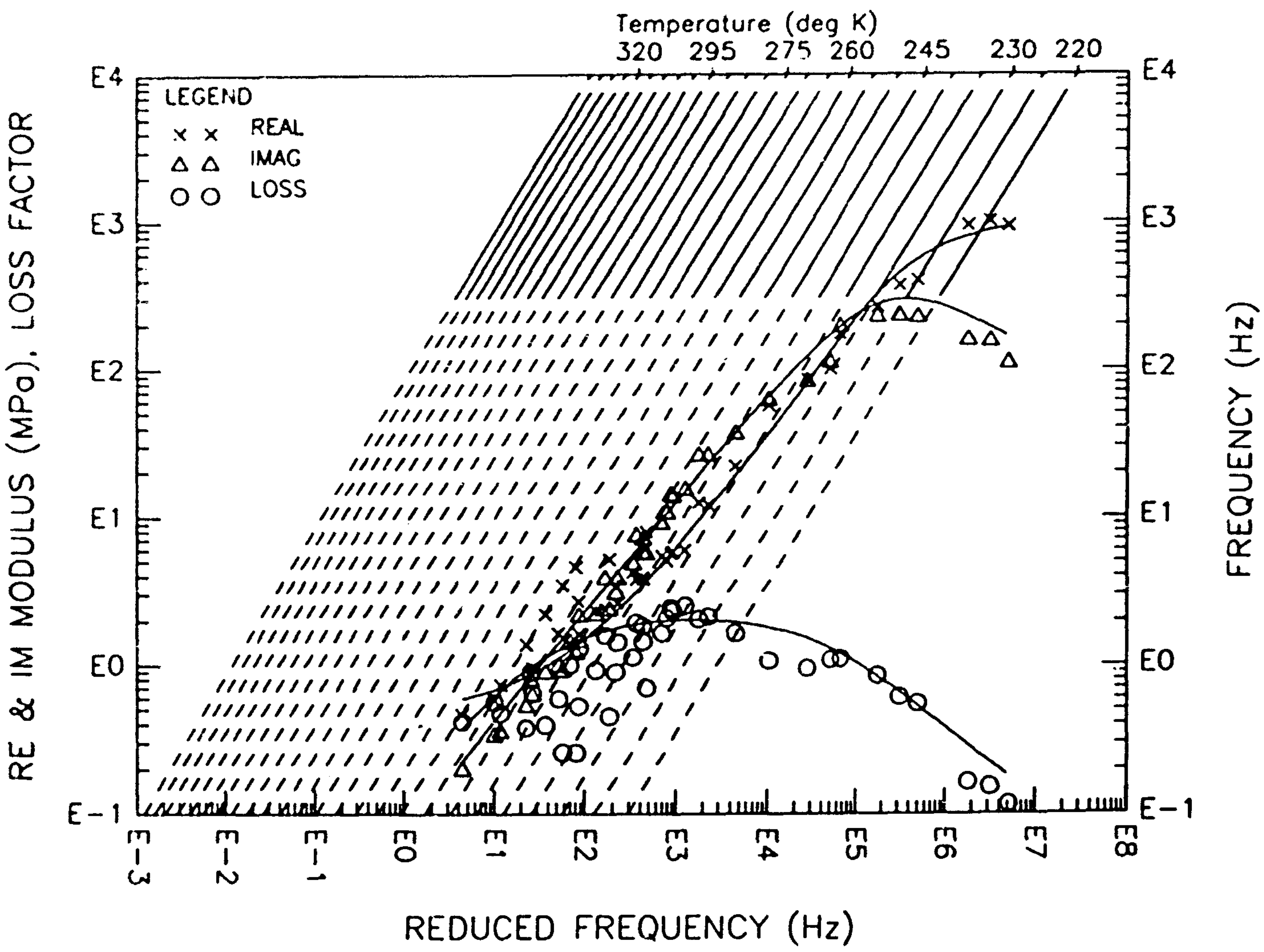
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
322.0	901.8	1.168	0.8018	0.9348
322.0	1730.	1.202	0.7882	0.9474

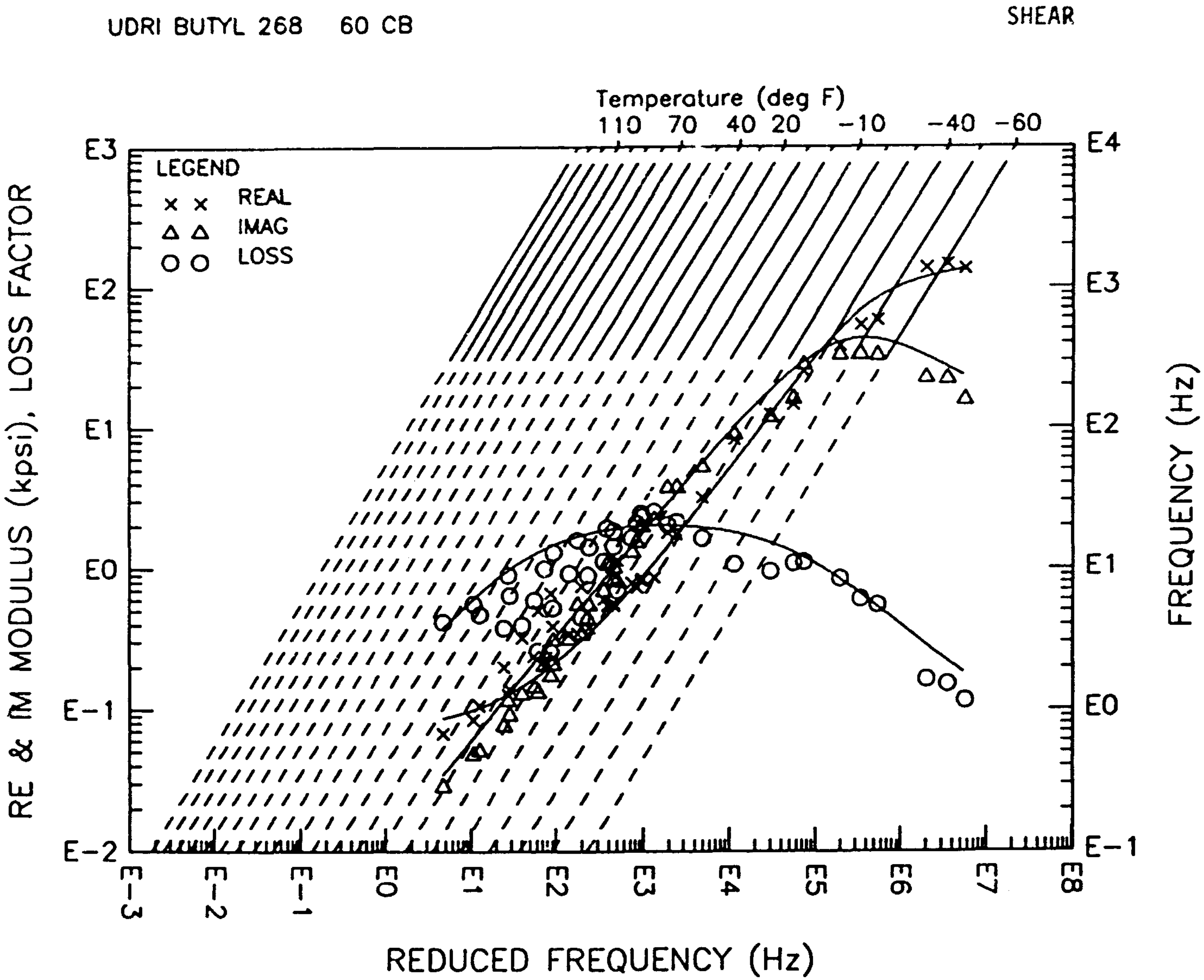
UDRI BUTYL 268 60 CB

SHEAR

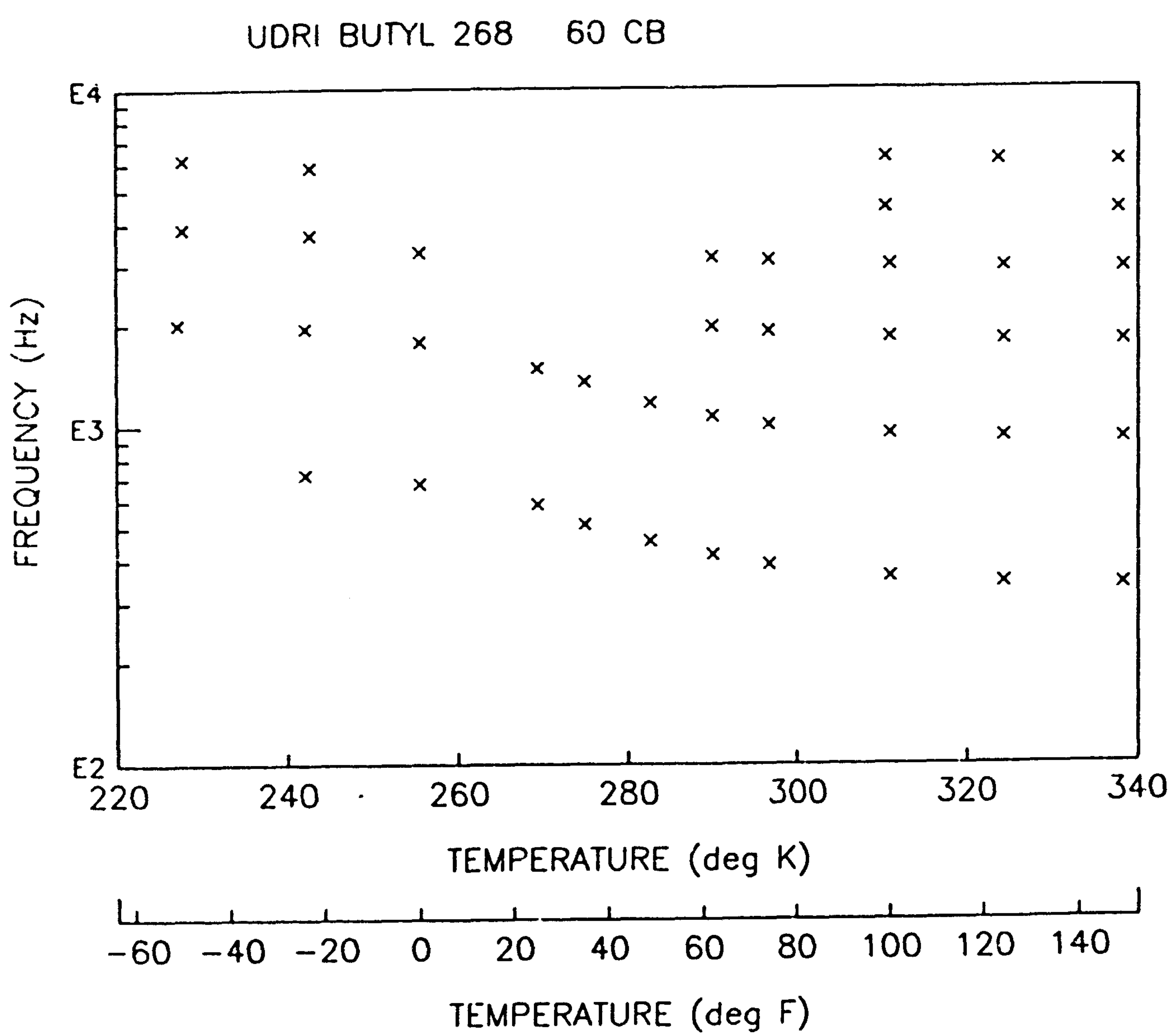
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		6.1509	1.418	2.026	1.418	0.3805
MODULUS	MPA	914.8	0.0000E+00	8.883	1.358	0.5987
	PSI	0.1327E+06	0.0000E+00	1288.	197.0	86.84
10.HZ	DEG K		0.0000E+00	238.0	261.0	
	DEG C		-293.1	-55.15	-32.15	
	DEG F		-495.7	-67.27	-25.87	
100.HZ	DEG K		232.0	256.0	283.0	
	DEG C		-61.15	-37.15	-10.15	
	DEG F		-78.07	-34.87	13.73	
1000.HZ	DEG K		248.0	276.0	310.0	
	DEG C		-45.15	-17.15	16.85	
	DEG F		-49.27	1.130	62.33	

UDRI BUTYL 268   60 CB   SHEAR



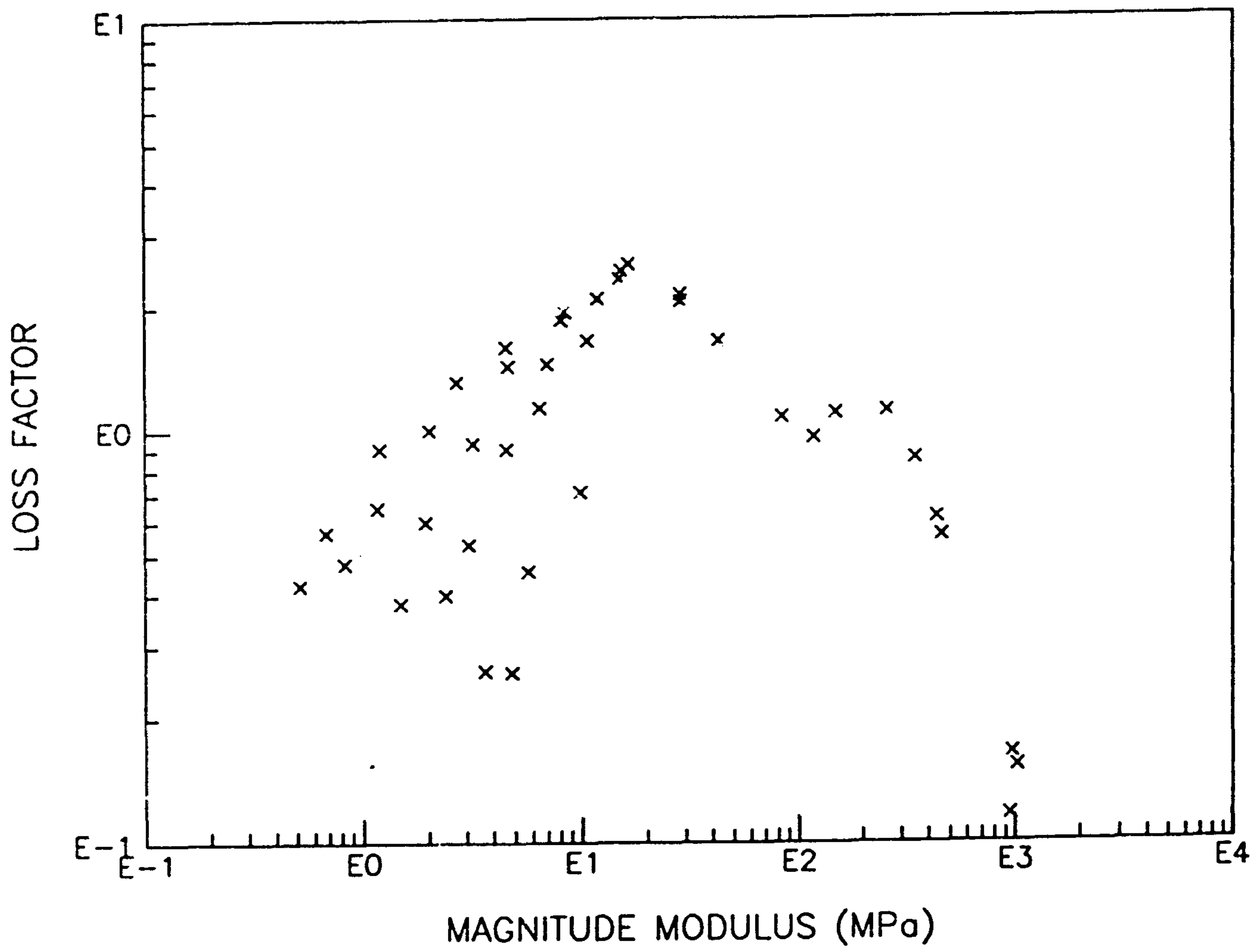


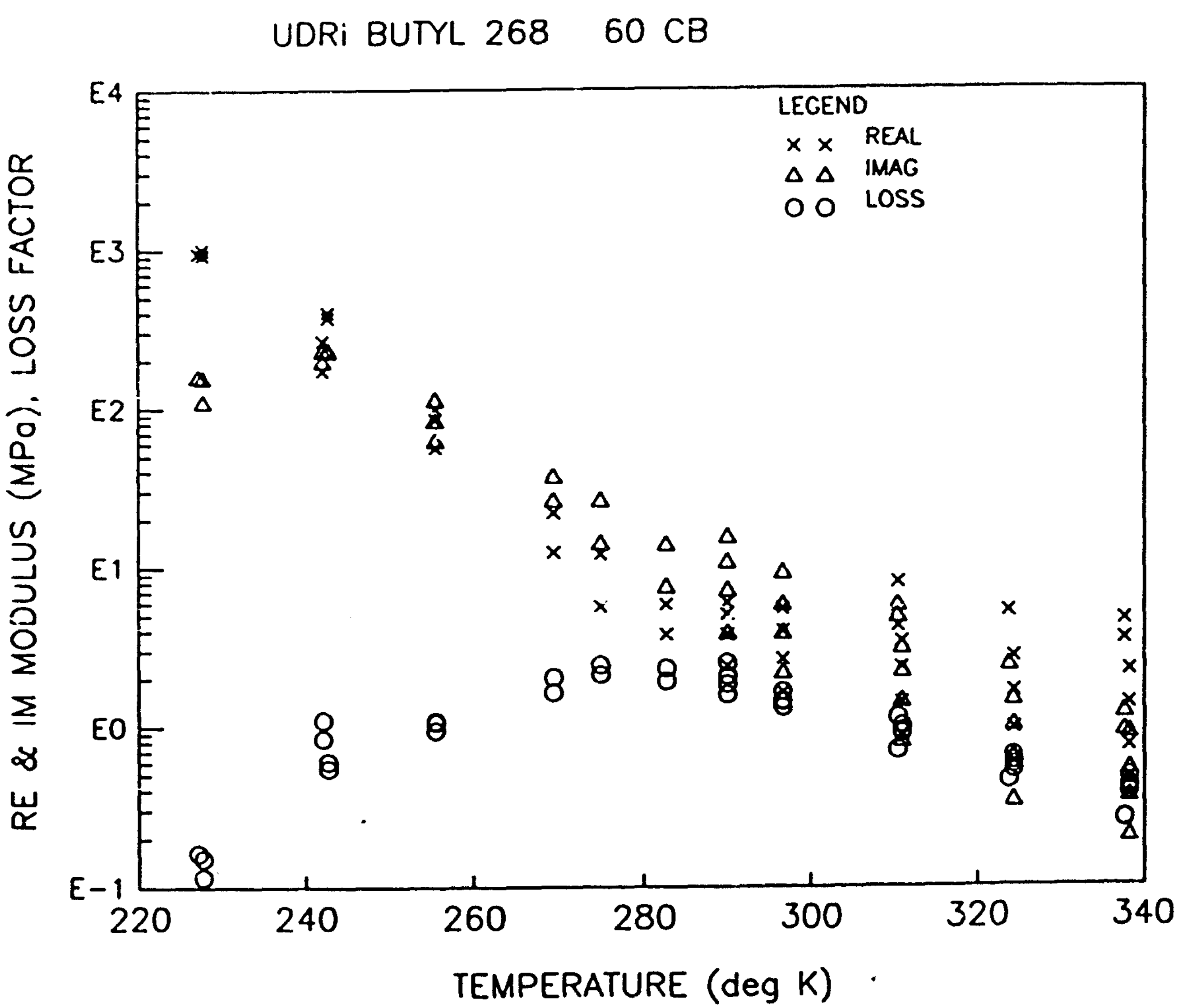
UDRI BUTYL 268 60 CB
SHEAR
Temperature (deg F)
110 70 40 20 -10 -40 -60
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)
E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8

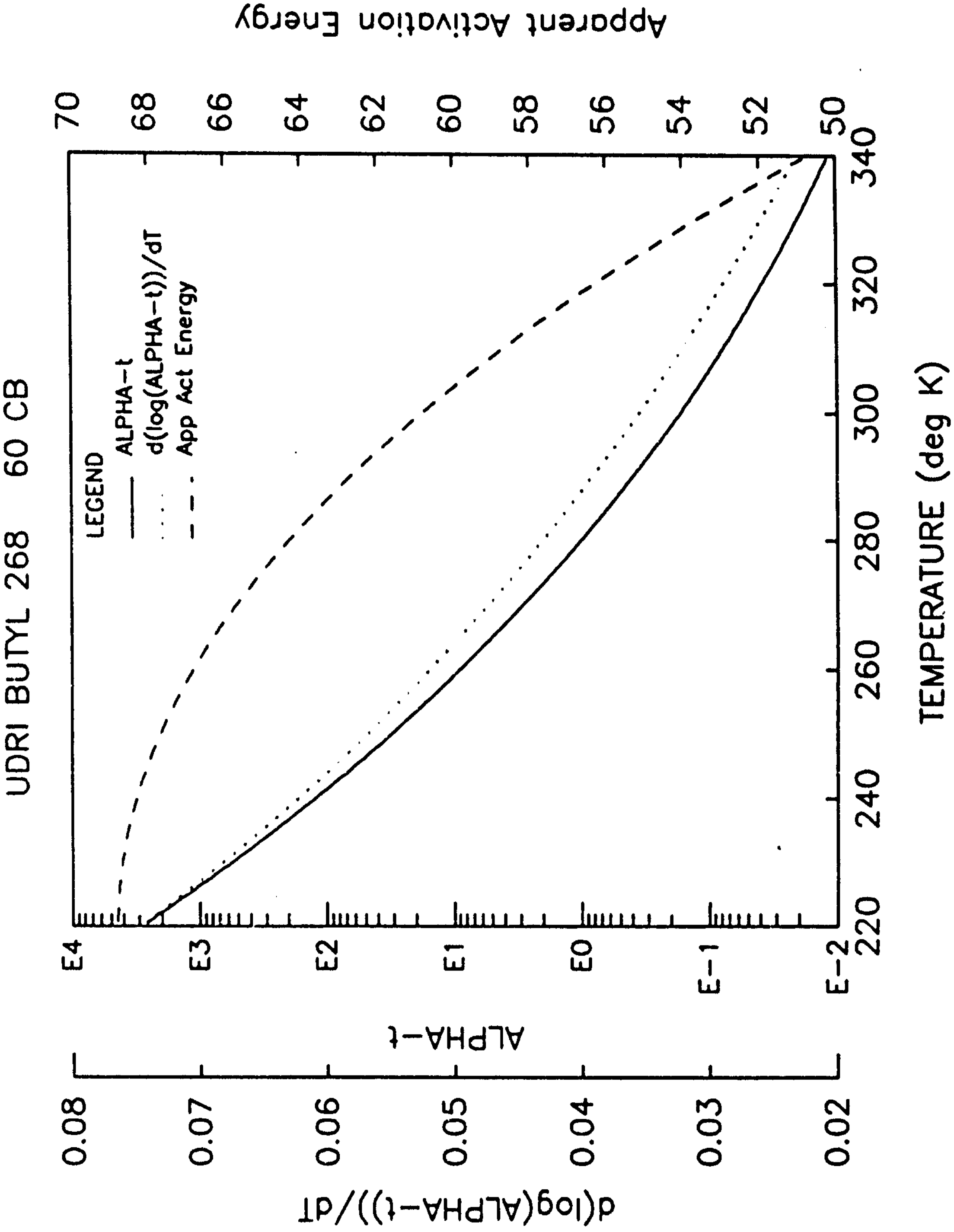


UDRI BUTYL 268 60 CB
FREQUENCY (Hz)
E4
E3
E2
220
240
260
280
300
320
340
TEMPERATURE (deg K)
-60
-40
-20
0
20
40
60
80
100
120
140
TEMPERATURE (deg F)

UDRI BUTYL 268 60 CB




UDRi BUTYL 268 60 CB
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
E-1
220
240
260
280
300
320
340
TEMPERATURE (deg K)


UDRI BUTYL 268 60 CB
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
220
240
260
280
300
320
340
ALPHA-t
E-2
E-1
E0
E1
E2
E3
E4
d(log(ALPHA-t))/dT
0.02
0.03
0.04
0.05
0.06
0.07
0.08
Apparent Activation Energy
50
52
54
56
58
60
62
64
66
68
70

UDRI BUTYL 268 60%CB SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	280.0	220.0	340.0	0.4300E-01	0.7456E-01	0.2300E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.5000	1800.	0.7000E+06	0.7400	1.000	0.1000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

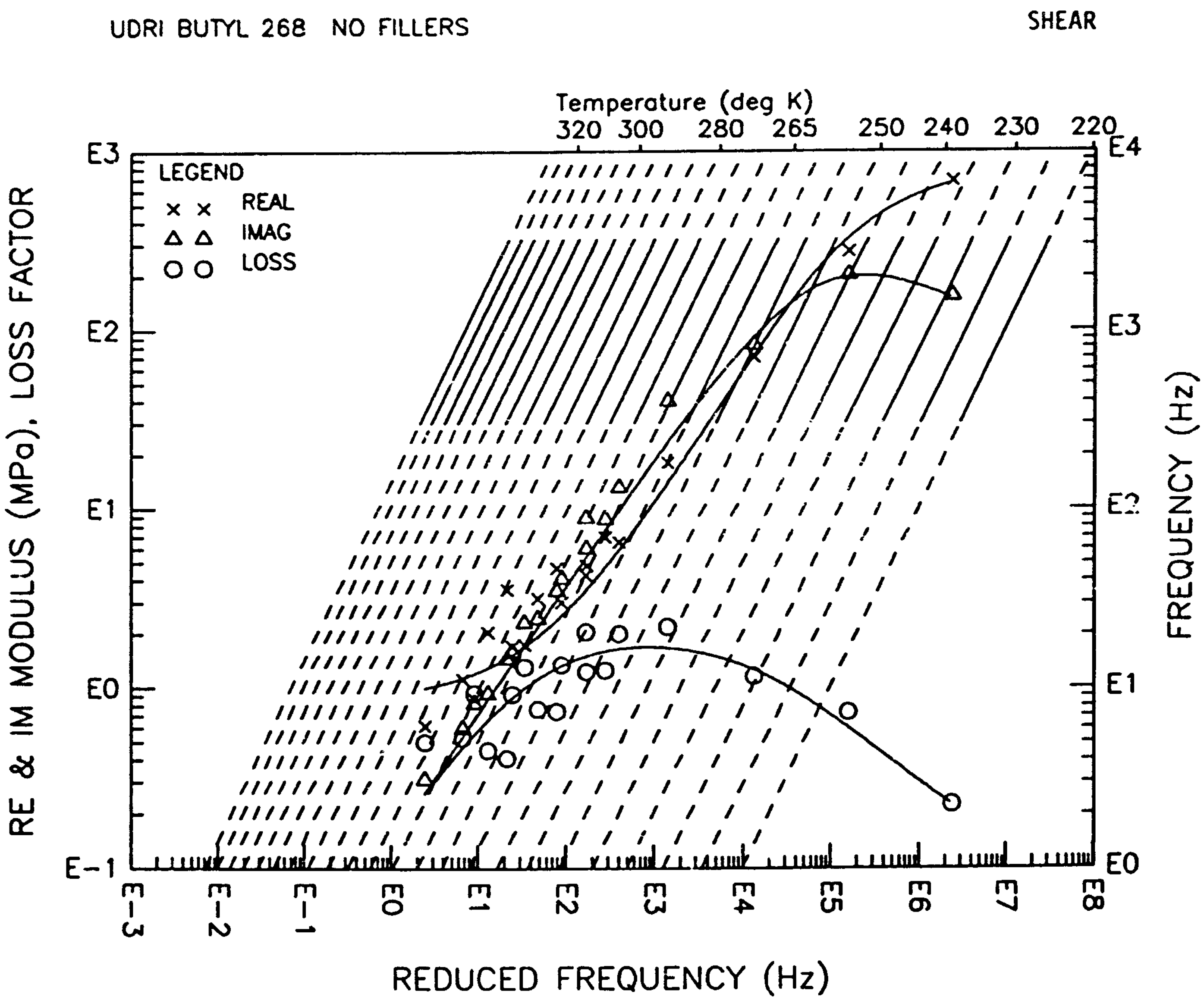
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
338.2	336.8	0.4716	0.4209	0.1985
338.2	911.5	0.7412	0.4753	0.3523
338.2	1773.	1.378	0.3799	0.5235
338.2	2918.	2.218	0.3975	0.8817
337.6	4347.	3.487	0.2608	0.9094
337.6	6058.	4.622	0.2577	1.191
324.3	343.0	0.5878	0.5660	0.3327
324.3	924.3	0.9687	0.6463	0.6261
324.3	1790.	1.649	0.5979	0.9859
324.3	2949.	2.709	0.5277	1.430
323.7	6103.	5.184	0.4532	2.349
310.9	357.0	0.8805	0.8992	0.7917
310.9	946.1	1.411	1.002	1.414
310.9	1824.	2.337	0.9275	2.168
310.9	2989.	3.388	0.8985	3.044
310.4	4415.	4.231	1.130	4.781
310.4	6229.	7.936	0.7054	5.598
296.5	1004.	2.647	1.427	3.777
296.5	1898.	3.940	1.445	5.693
296.5	3093.	5.450	1.647	8.976
282.6	456.0	3.805	1.936	7.366
282.6	1170.	5.830	2.327	13.57
269.3	586.3	12.47	2.048	25.54
269.3	1483.	22.03	1.644	36.22
289.8	414.5	2.398	1.590	3.813
289.8	1064.	3.797	1.846	7.009
289.8	1967.	5.080	2.080	10.57
289.8	3154.	6.006	2.523	15.15
274.8	511.1	5.622	2.440	13.89
274.8	1350.	12.08	2.134	25.78
255.4	672.9	56.90	1.072	61.00
255.4	1770.	85.22	0.9557	81.44
255.4	3268.	100.7	1.094	110.2
242.0	718.4	173.6	1.111	192.9
242.0	1948.	265.6	0.8501	225.8
242.6	3690.	371.4	0.6105	226.7
242.6	5857.	402.1	0.5524	222.1
227.0	2017.	946.0	0.1641	155.2
227.6	3865.	1001.	0.1520	152.2
227.6	6203.	930.1	0.1163	108.2

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
296.5	387.7	1.633	1.309	2.138

UDRI BUTYL 268 NO FILLERS

SHEAR

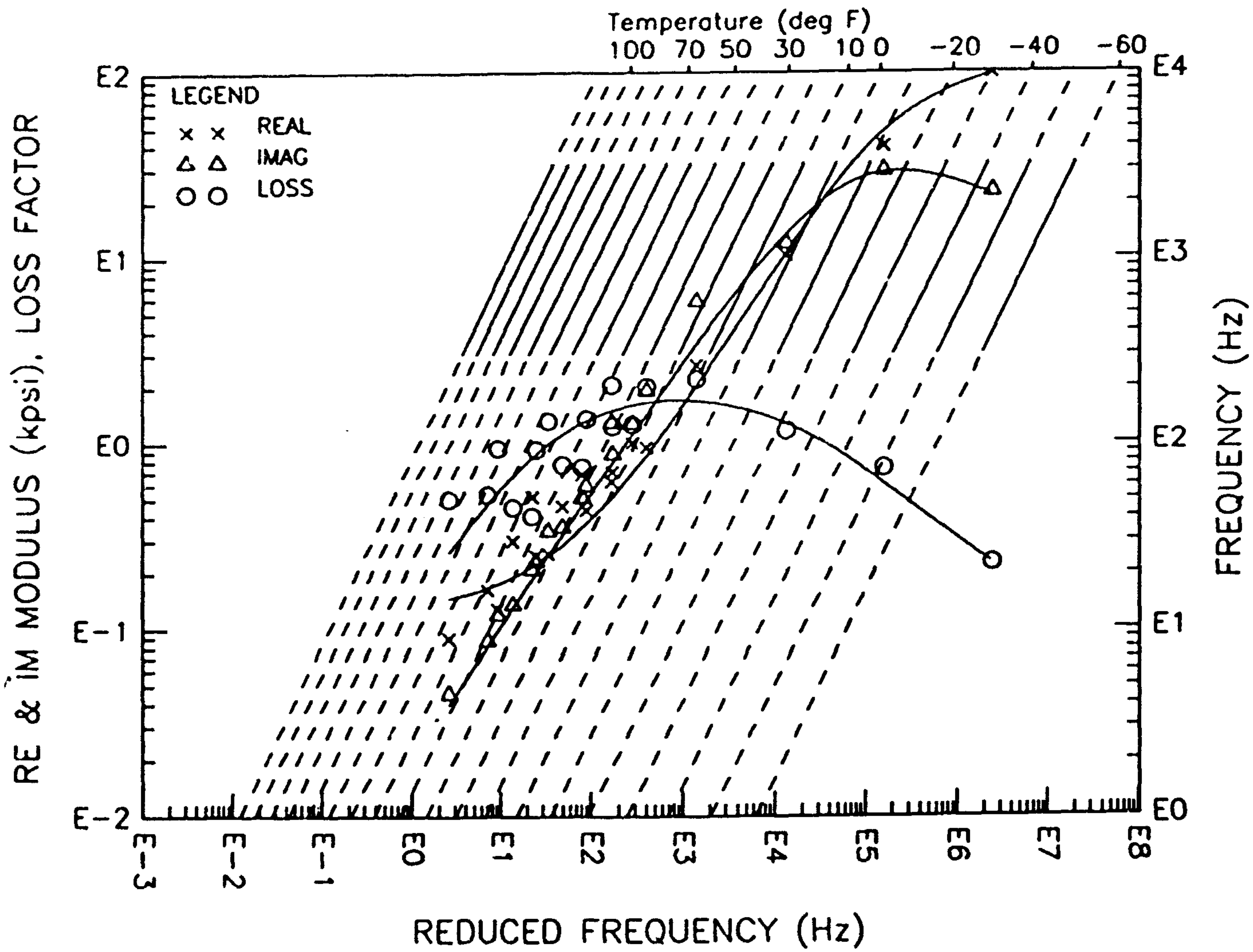
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.2258	1.176	1.681	1.176	0.2593
MODULUS	MPA	663.5	91.71	9.551	2.119	1.010
	PSI	0.9623E+05	0.1330E+05	1385.	307.3	146.5
	DEG K		228.0	245.0	262.0	
10.HZ	DEG C		-65.15	-48.15	-31.15	
	DEG F		-85.27	-54.67	-24.07	
	DEG K		240.0	259.0	280.0	
100.HZ	DEG C		-53.15	-34.15	-13.15	
	DEG F		-63.67	-29.47	8.330	
	DEG K		254.0	277.0	302.0	
1000.HZ	DEG C		-39.15	-16.15	8.850	
	DEG F		-38.47	2.930	47.93	

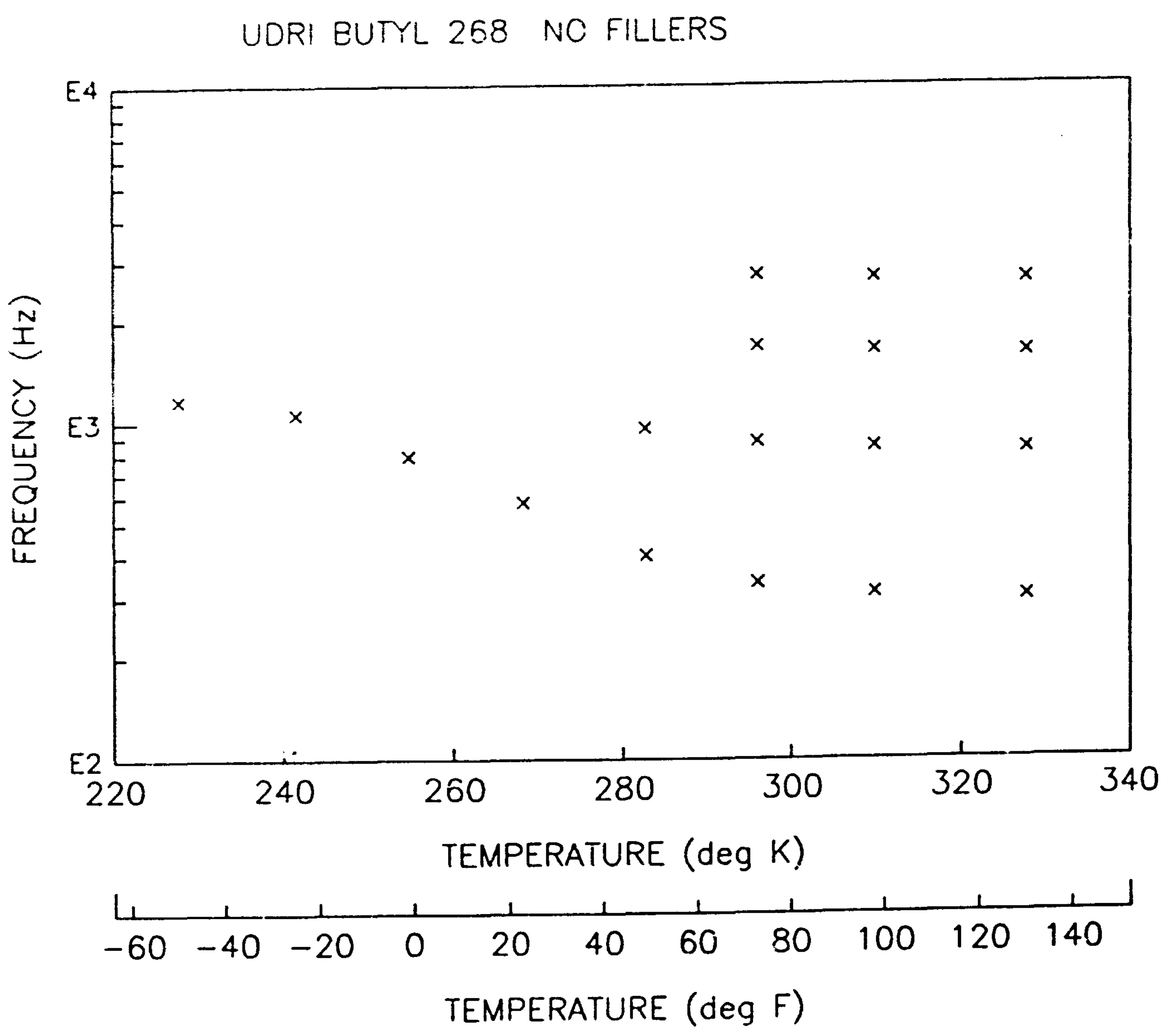


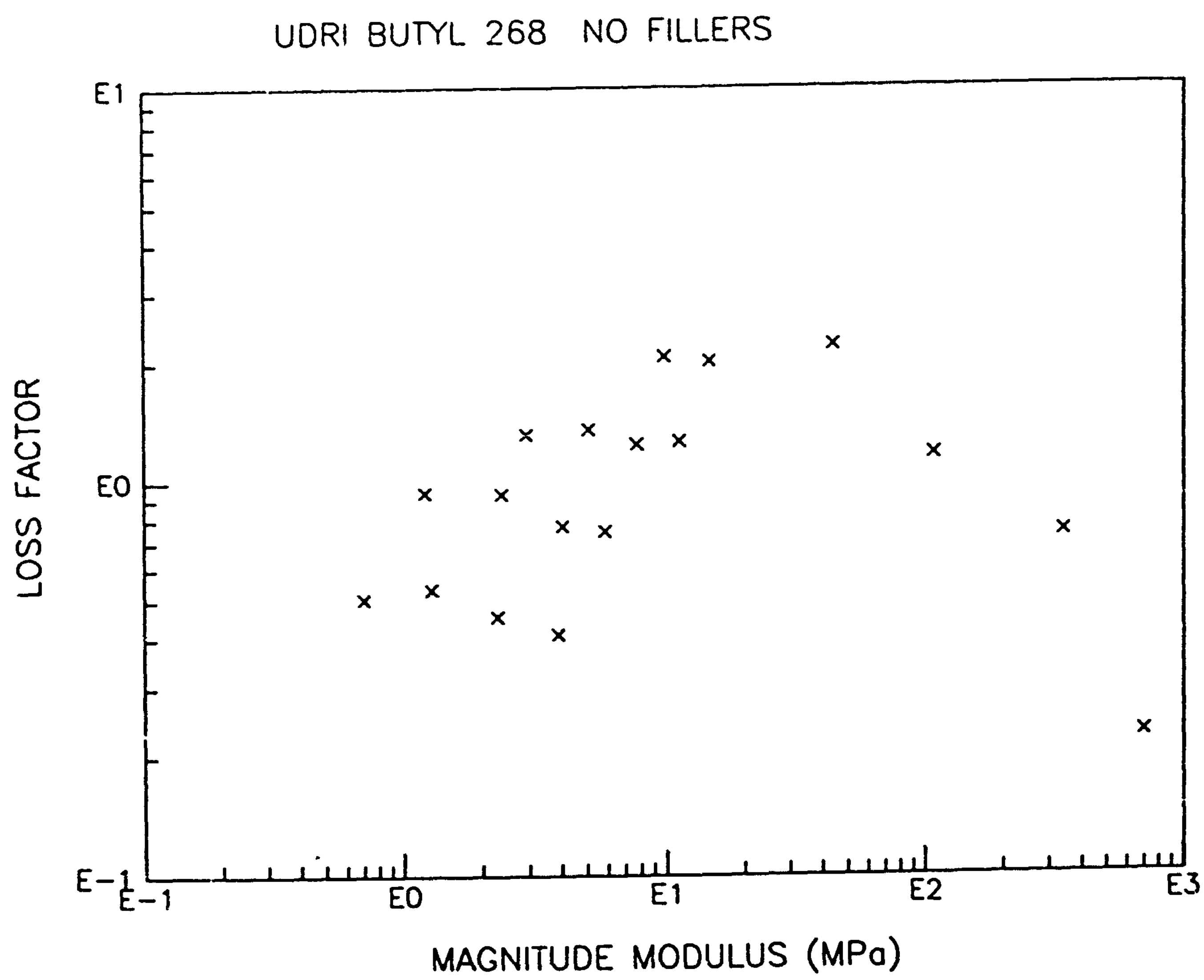
UDRI BUTYL 268 NO FILLERS
SHEAR
Temperature (deg K)
320 300 280 265 250 240 230 220
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
FREQUENCY (Hz)
E4
E3
E2
E1
E0
E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8
REDUCED FREQUENCY (Hz)

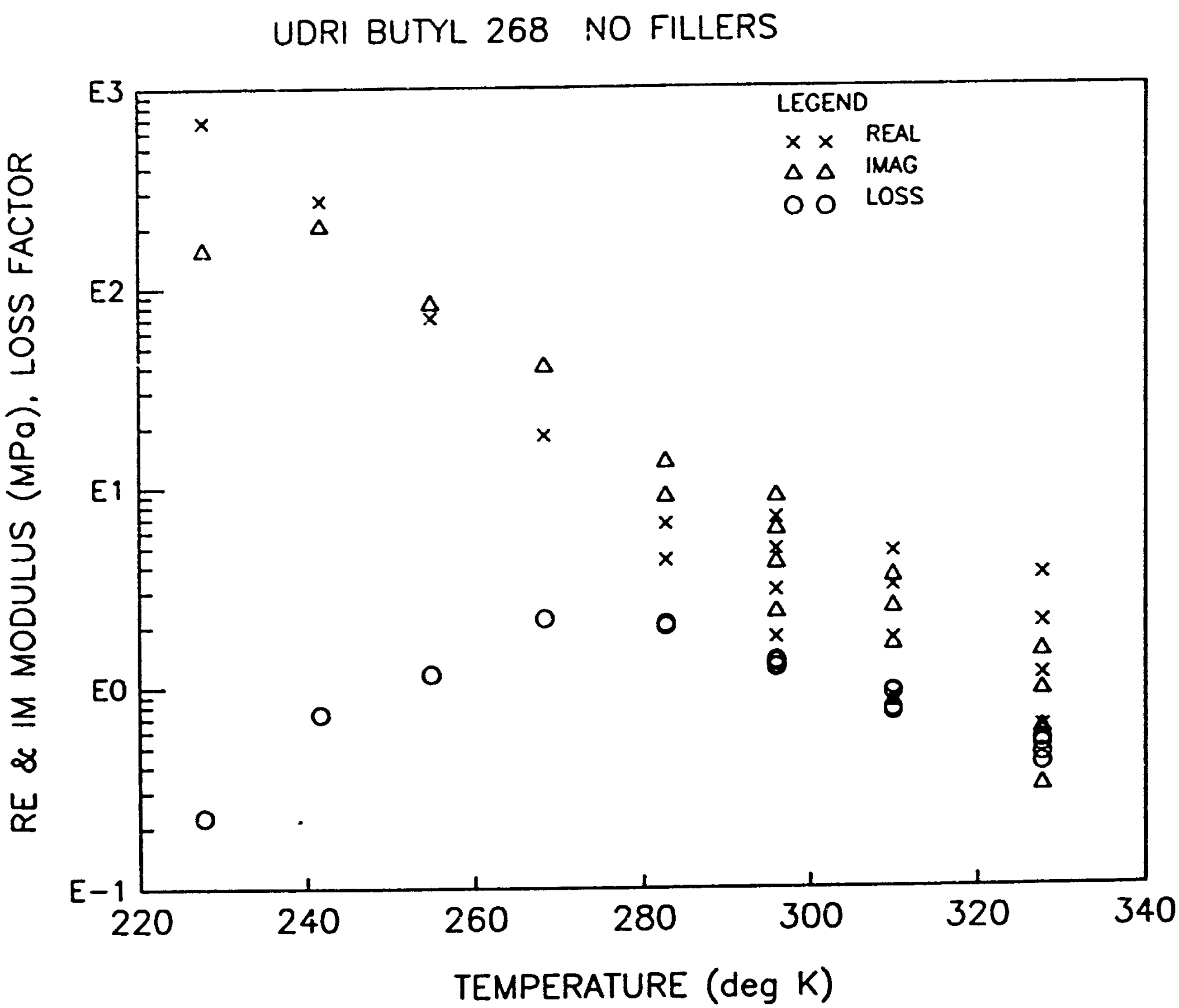
UDRI BUTYL 268 NO FILLERS

SHEAR

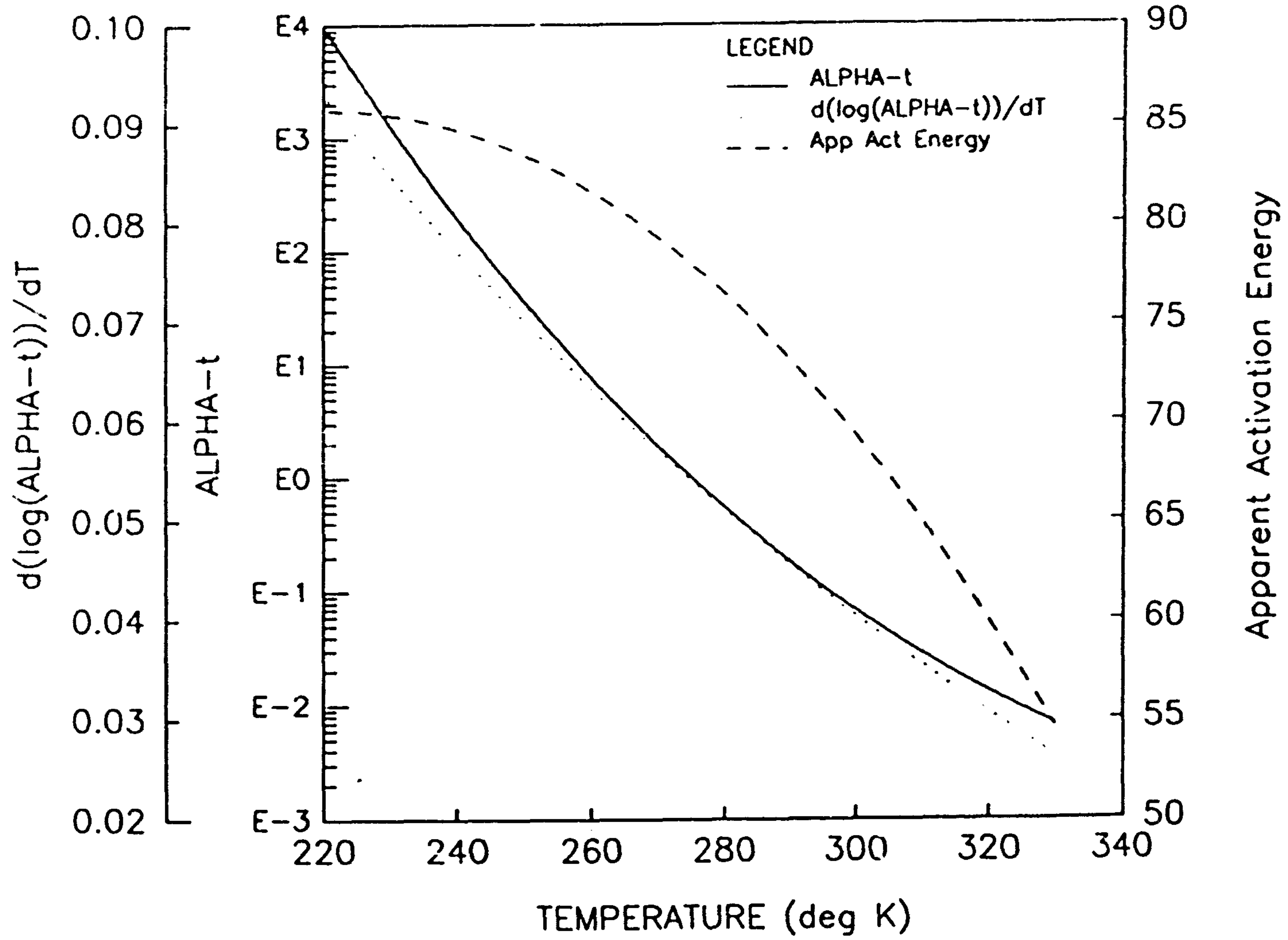



UDRI BUTYL 268 NC FILLERS
FREQUENCY (Hz)
E4
E3
E2
220
240
260
280
300
320
340
TEMPERATURE (deg K)
-60
-40
-20
0
20
40
60
80
100
120
140
TEMPERATURE (deg F)


UDRI BUTYL 268 NO FILLERS
LOSS FACTOR
E1
E0
E-1
E-1
E0
E1
E2
E3
MAGNITUDE MODULUS (MPa)


UDRI BUTYL 268 NO FILLERS
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E-1
220
240
260
280
300
320
340
TEMPERATURE (deg K)

UDRI BUTYL 268 NO FILLERS



UDRI BUTYL 268 NO FILLERS SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	275.0	220.0	330.0	0.5400E-01	0.9285E-01	0.2620E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.8864	1200.	0.2500E+06	0.7200	1.045	0.2000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

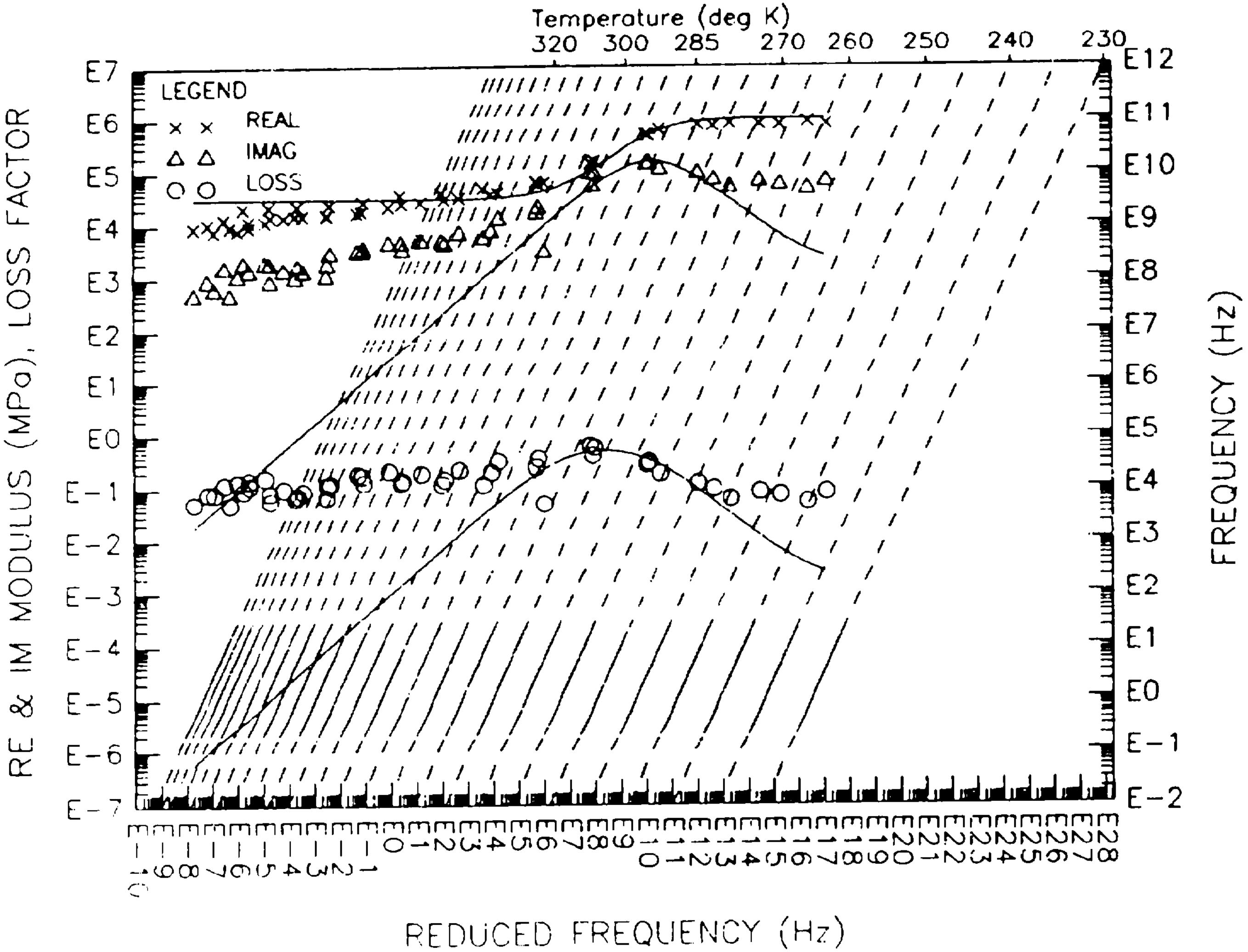
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
327.6	301.4	0.6204	0.5036	0.3124
327.6	822.6	1.129	0.5320	0.6006
327.6	1601.	2.061	0.4543	0.9363
327.6	2640.	3.567	0.4091	1.459
309.8	309.6	0.8812	0.9394	0.8278
309.8	839.1	1.722	0.9307	1.603
309.8	1631.	3.179	0.7701	2.448
309.8	2377.	4.699	0.7449	3.500
295.9	333.0	1.765	1.318	2.326
295.9	871.3	3.027	1.352	4.093
295.9	1672.	4.860	1.241	6.031
295.9	2734.	6.964	1.260	8.775
282.6	402.4	4.296	2.069	8.888
282.6	958.5	6.555	2.014	13.20
263.2	577.7	18.14	2.207	40.03
254.8	793.2	70.60	1.166	82.32
241.5	1061.	274.0	0.7380	201.7
227.6	1171.	680.3	0.2263	154.0

FORCN 05 SHEAR

		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.2399E-02	0.3289	0.4699	0.3289	0.6021E-06
MODULUS	MPA	0.1008E+07	0.5089E+06	0.1575E+06	0.5698E+05	0.3000E+05
	PSI	0.1461E+09	0.7380E+08	0.2284E+08	0.8264E+07	0.4351E+07
10.HZ	DEG K		251.0	257.0	263.0	
	DEG C		-42.15	-36.15	-30.15	
	DEG F		-43.87	-33.07	-22.27	
100.HZ	DEG K		254.0	260.0	266.0	
	DEG C		-39.15	-33.15	-27.15	
	DEG F		-38.47	-27.67	-16.87	
1000.HZ	DEG K		257.0	284.0	270.0	
	DEG C		-36.15	-29.15	-23.15	
	DEG F		-33.07	-20.47	-9.670	

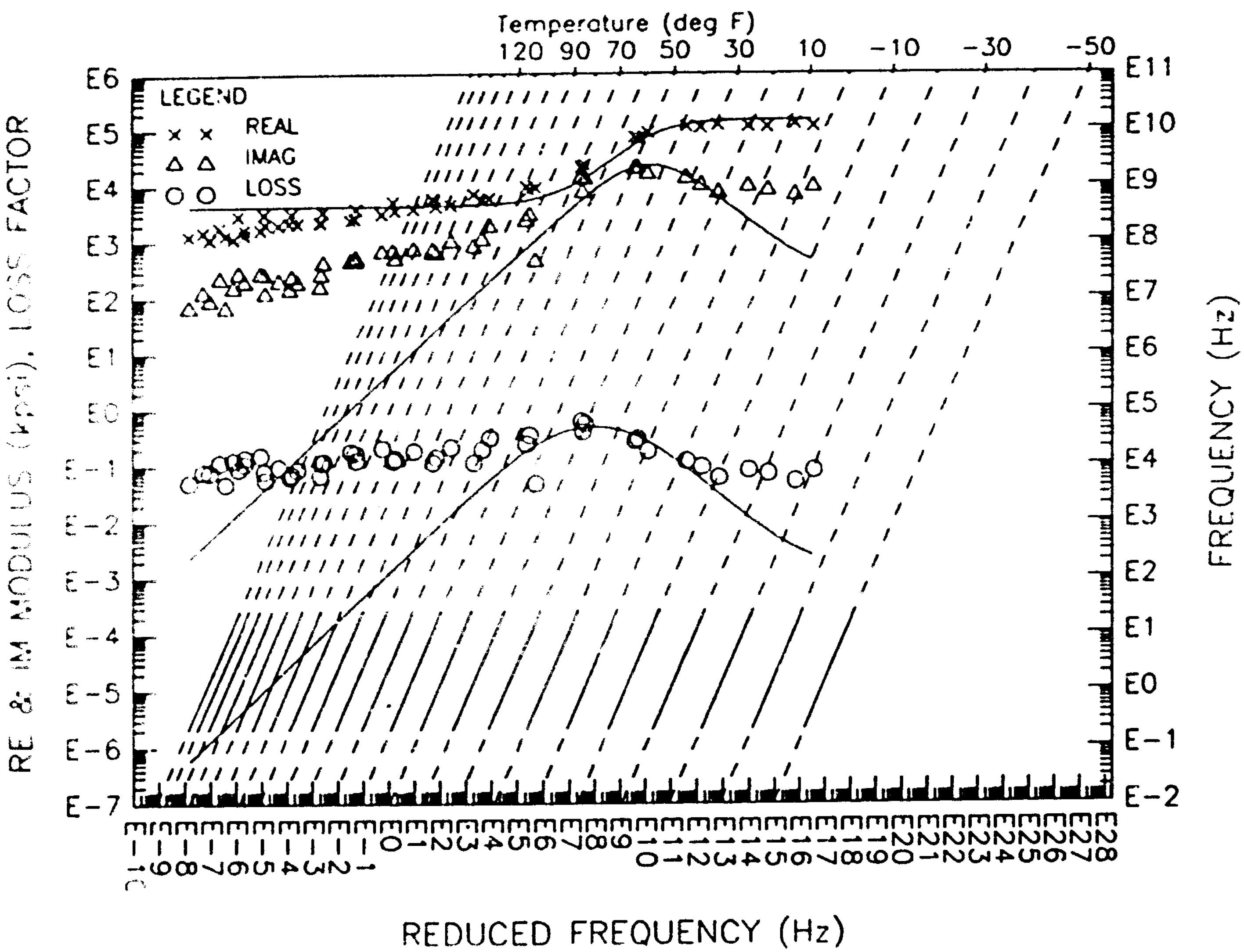
PORON 05

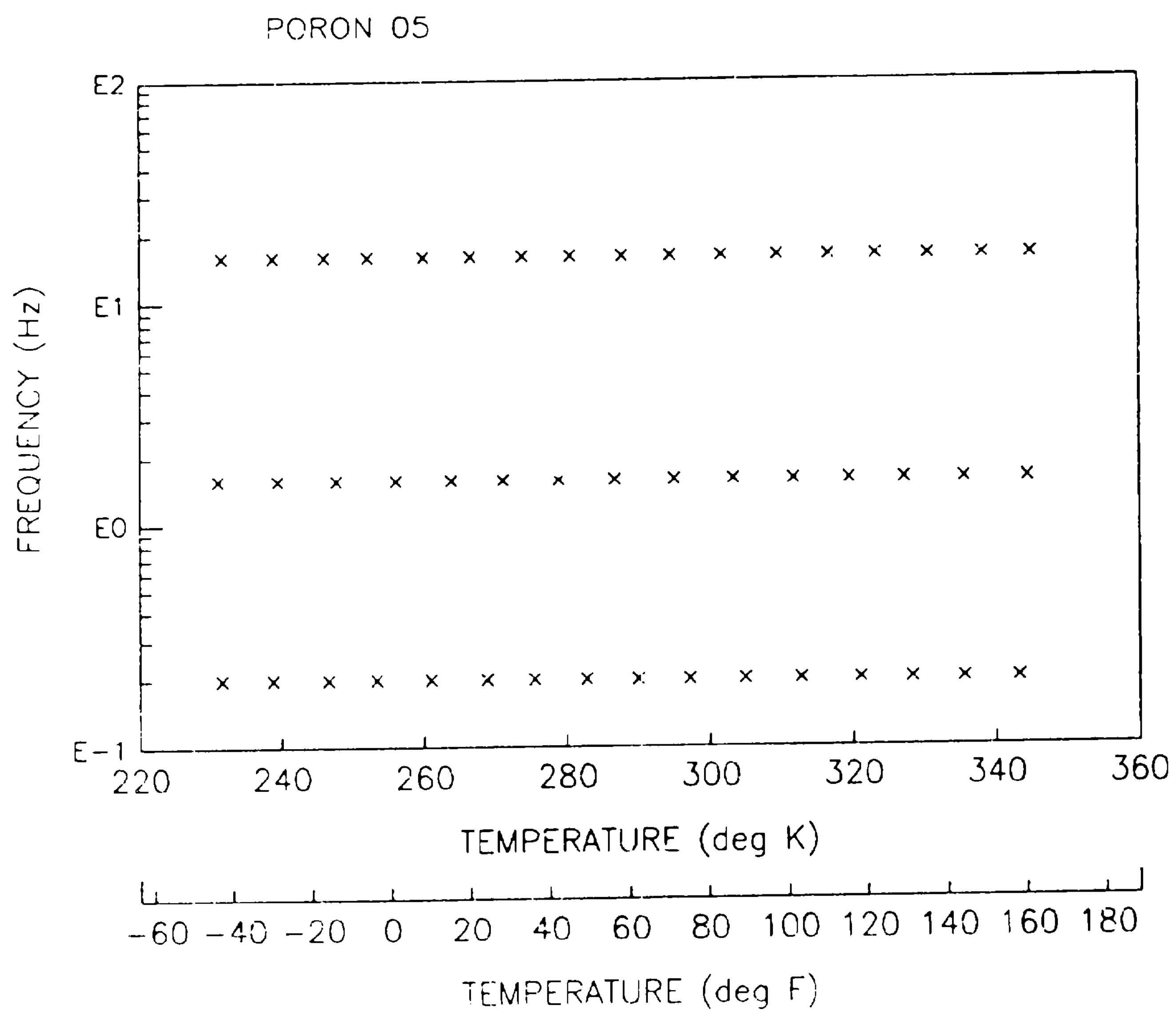
SHEAR

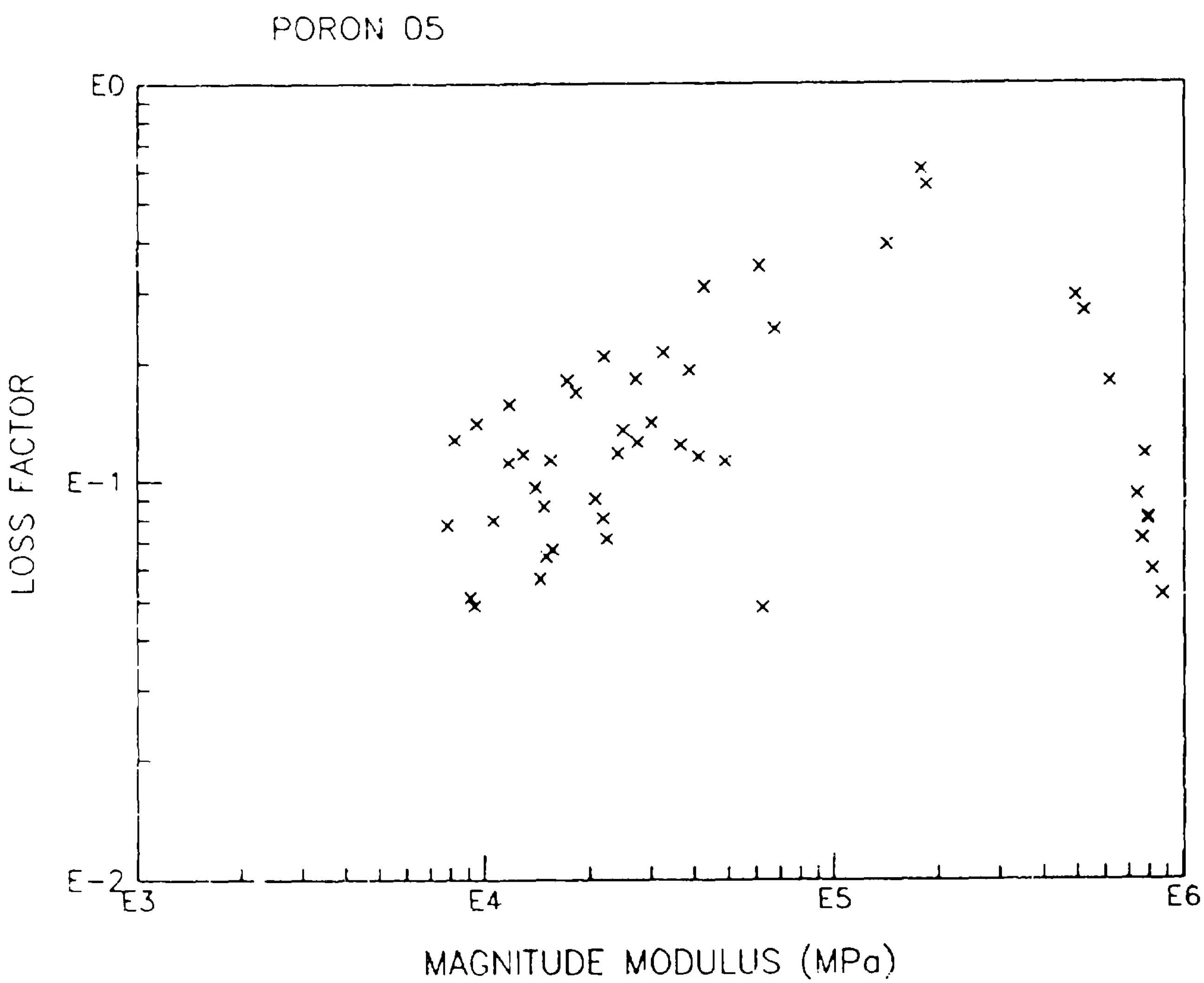


PORON 05

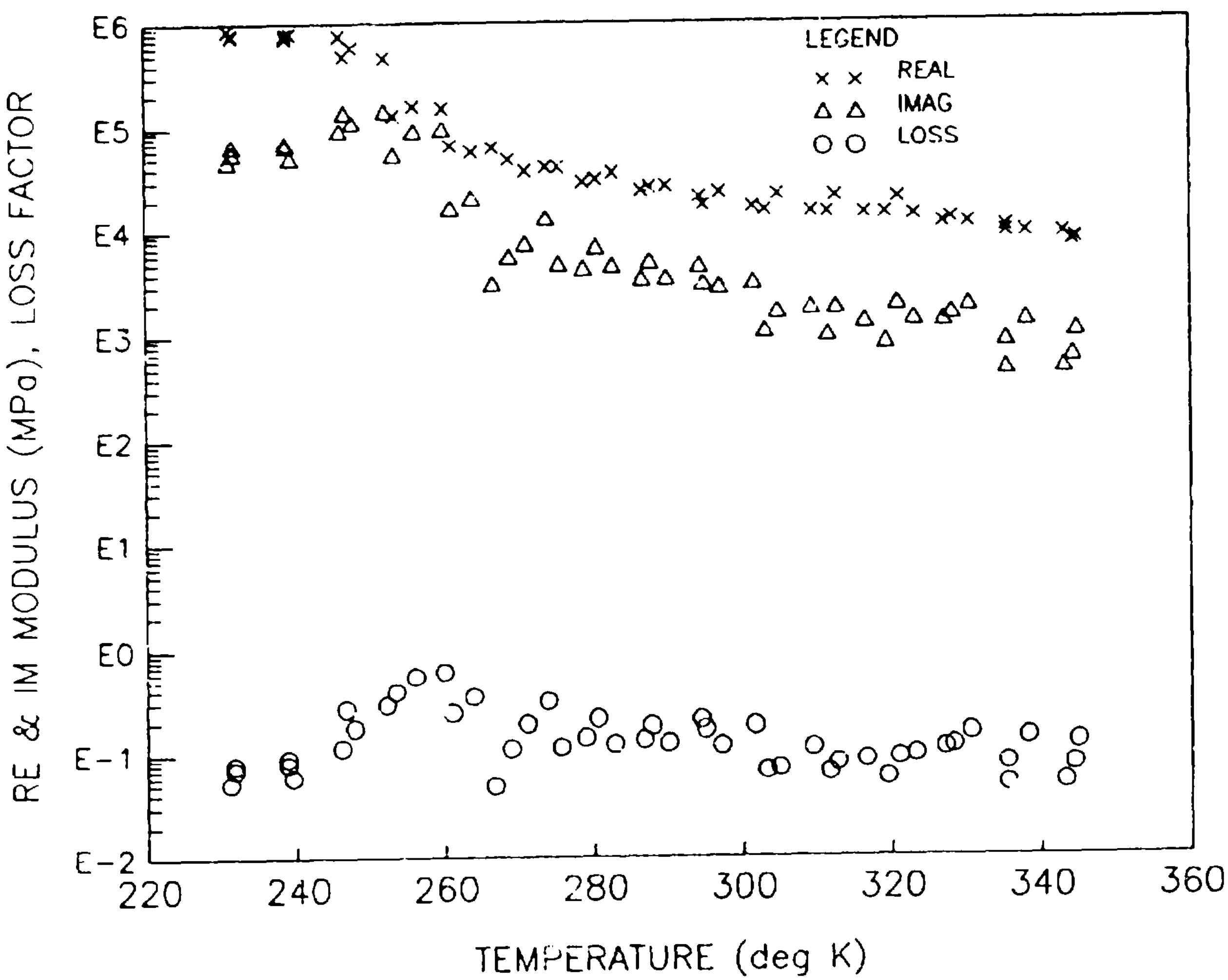
SHEAR




PORON 05
E2
E1
E0
E-1
FREQUENCY (Hz)
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
TEMPERATURE (deg F)

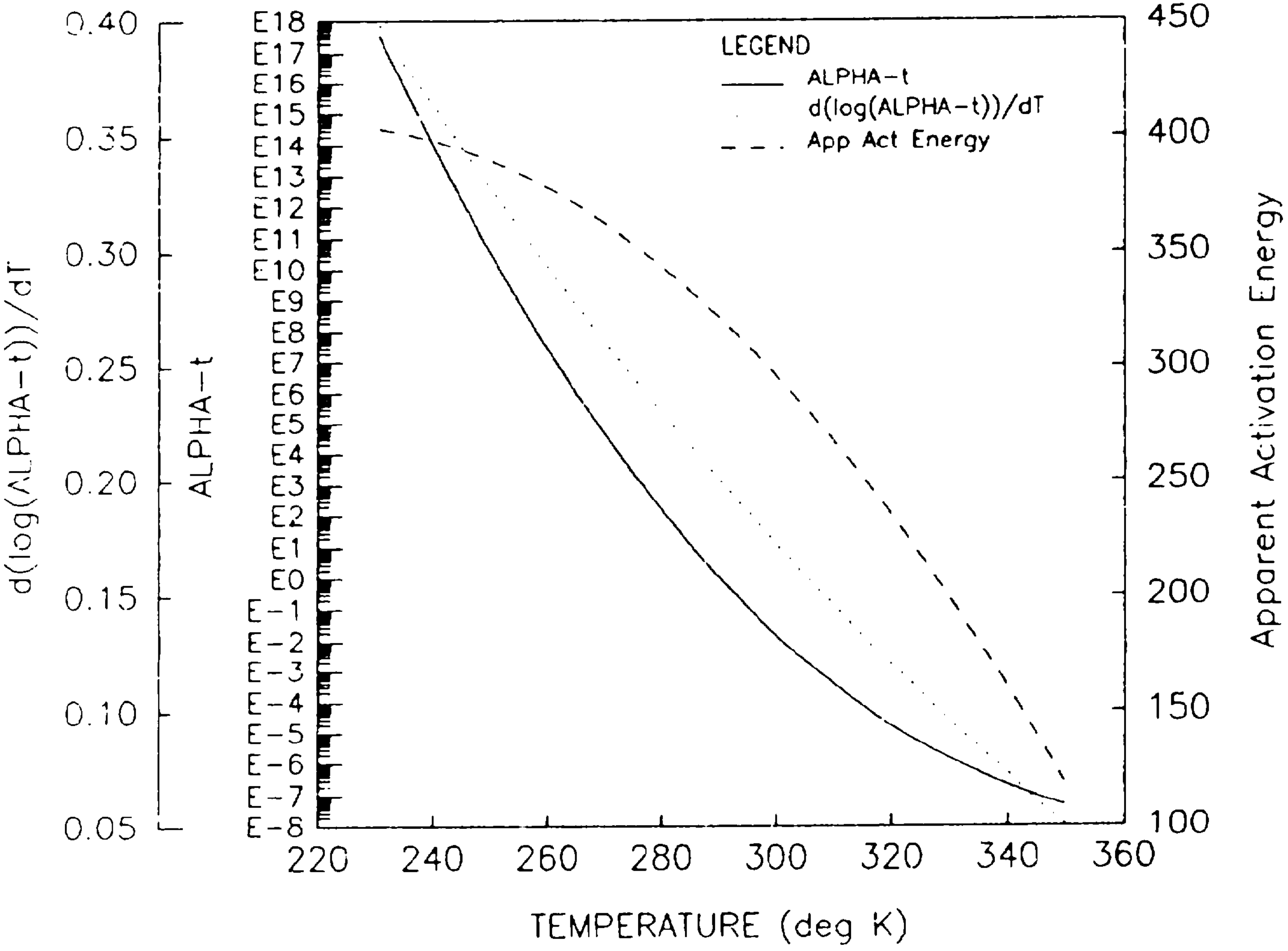

PORON 05
LOSS FACTOR
E0
E-1
E-2
E3
E4
E5
E6
MAGNITUDE MODULUS (MPa)

PORON 05



LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)

PORON 05



LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
ALPHA-t
E18
E17
E16
E15
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
E-5
E-6
E-7
E-8
Apparent Activation Energy
450
400
350
300
250
200
150
100
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)

PORON 05 SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	290.0	230.0	350.0	0.2000	0.4000	0.5000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.3000E+05	0.1000E+07	0.1500E+12	0.4000	0.5000E-01	0.8000E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

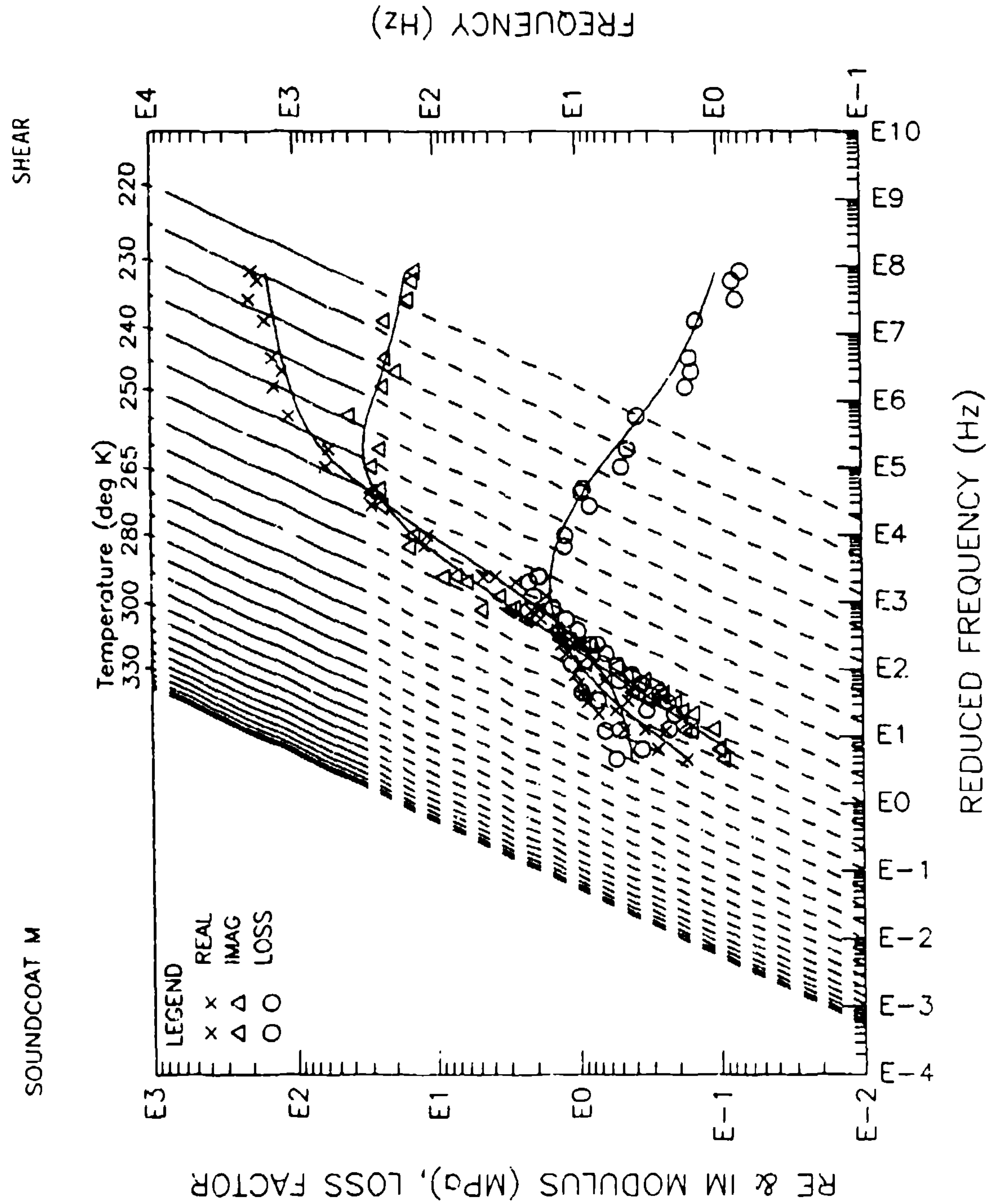
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
231.8	16.00	0.7847E+06	0.7950E-01	0.6238E+05
238.7	16.00	0.7840E+06	0.8050E-01	0.6311E+05
245.9	16.00	0.7647E+06	0.1170	0.8947E+05
252.0	16.00	0.4682E+06	0.2934	0.1374E+06
259.8	16.00	0.1502E+06	0.6076	0.9129E+05
266.8	16.00	0.6179E+05	0.4800E-01	2966.
273.7	16.00	0.4016E+05	0.3096	0.1243E+05
280.4	16.00	0.3139E+05	0.2120	6655.
287.6	16.00	0.2639E+05	0.1819	4800.
294.3	16.00	0.2127E+05	0.2074	4411.
301.5	16.00	0.1682E+05	0.1801	3029.
309.3	16.00	0.1522E+05	0.1132	1723.
316.8	16.00	0.1468E+05	0.8630E-01	1264.
323.1	16.00	0.1380E+05	0.9630E-01	1329.
330.4	16.00	0.1155E+05	0.1564	1806.
338.1	16.00	9308.	0.1402	1305.
344.8	16.00	8046.	0.1277	1027.
230.9	1.600	0.8619E+06	0.5170E-01	0.4456E+05
239.3	1.600	0.8109E+06	0.5950E-01	0.4825E+05
247.6	1.600	0.6021E+06	0.1782	0.1073E+06
255.9	1.600	0.1589E+06	0.5513	0.8760E+05
263.7	1.600	0.5712E+05	0.3459	0.1976E+05
270.9	1.600	0.3752E+05	0.1913	7178.
278.7	1.600	0.2942E+05	0.1414	4160.
286.5	1.600	0.2442E+05	0.1348	3292.
294.8	1.600	0.1784E+05	0.1676	2990.
303.1	1.600	0.1547E+05	0.6700E-01	1036.
311.5	1.600	0.1487E+05	0.6430E-01	956.1
319.3	1.600	0.1433E+05	0.5670E-01	812.5
327.0	1.600	0.1154E+05	0.1114	1286.
335.4	1.600	9274.	0.4870E-01	451.6
344.3	1.600	7729.	0.7730E-01	597.5
231.5	0.2000	0.7836E+06	0.7070E-01	0.5328E+05
238.7	0.2000	0.7274E+06	0.9190E-01	0.6685E+05
246.5	0.2000	0.4987E+06	0.2689	0.1341E+06
253.2	0.2000	0.1307E+06	0.3913	0.5114E+05
260.9	0.2000	0.6501E+05	0.2426	0.1577E+05
268.7	0.2000	0.4803E+05	0.1122	5389.
275.4	0.2000	0.4027E+05	0.1155	4651.
282.6	0.2000	0.3567E+05	0.1235	4405.

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
289.8	0.2000	0.2688E+05	0.1258	3382.
297.0	0.2000	0.2359E+05	0.1176	2774.
304.8	0.2000	0.2208E+05	0.7130E-01	1574.
312.6	0.2000	0.2159E+05	0.8040E-01	1736.
320.9	0.2000	0.2046E+05	0.9010E-01	1843.
328.1	0.2000	0.1274E+05	0.1173	1494.
335.4	0.2000	0.1049E+05	0.7970E-01	836.1
343.1	0.2000	9012.	0.5100E-01	459.6

SOUNDCOAT M

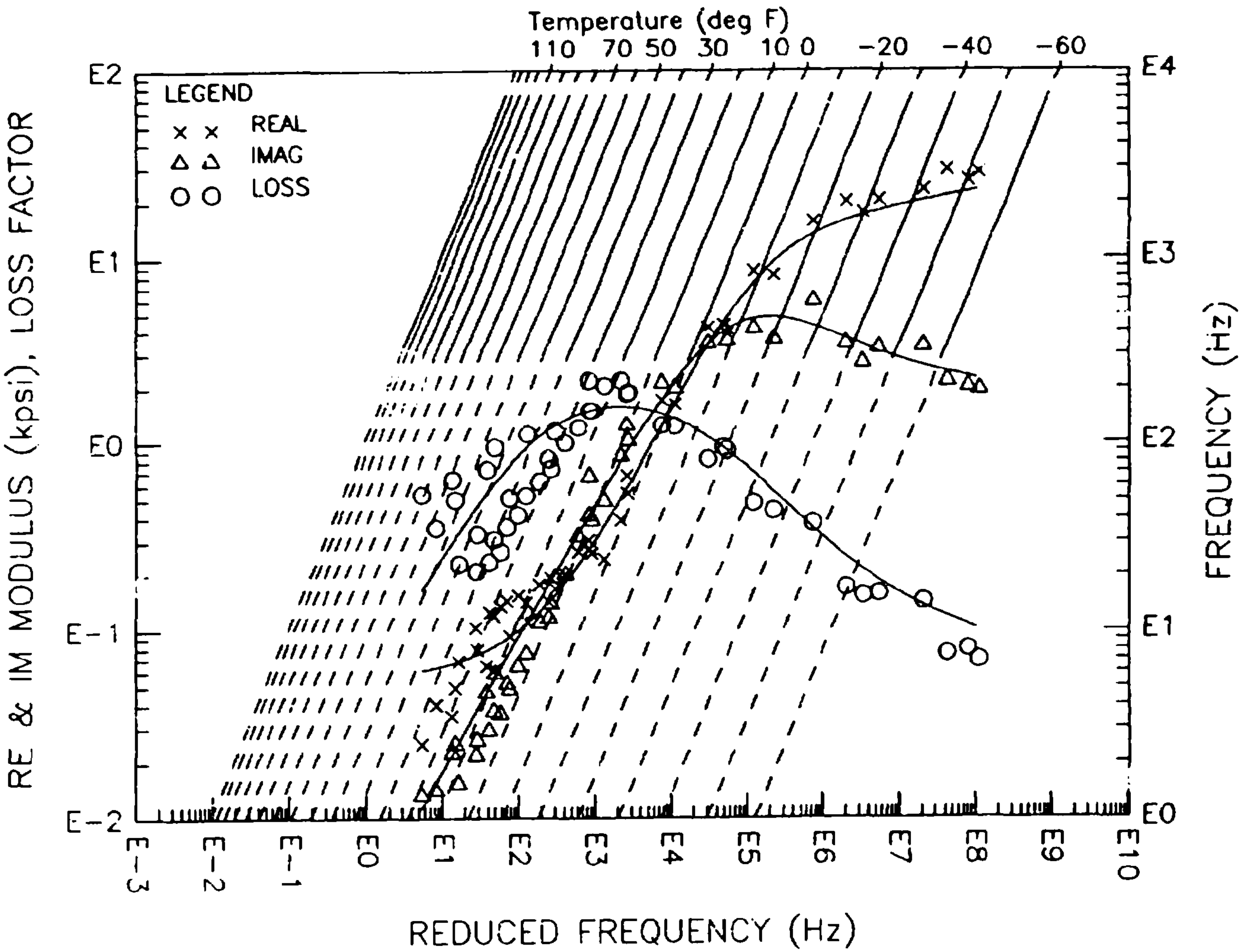
SHEAR

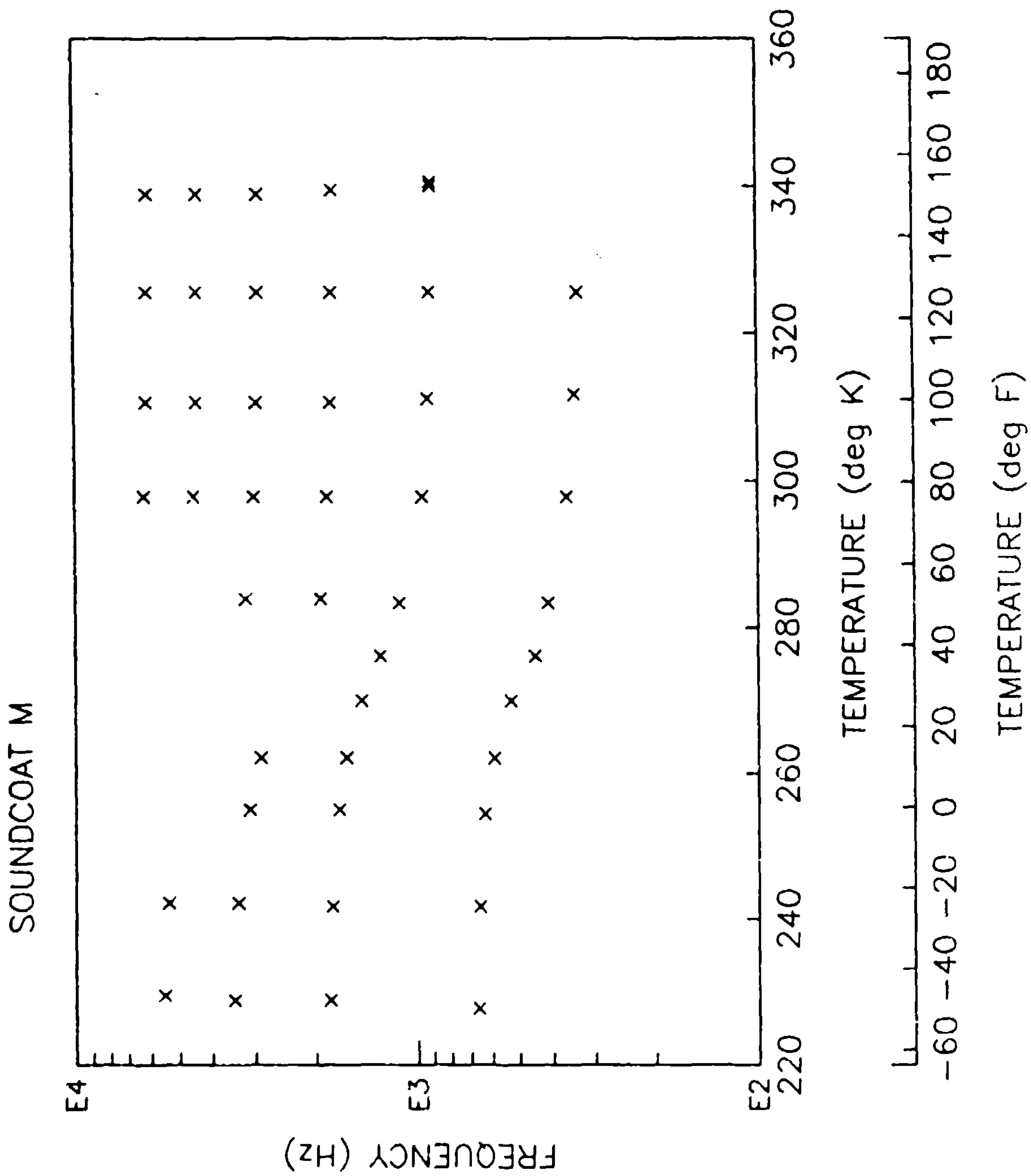
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1018	1.097	1.[illegible]67	1.[illegible]97	0.1653
MODULUS	MPA	153.7	20.22	2.797	0.8390	0.4204
	PSI	0.2229E+05	2932.	405.7	121.7	60.97
	DEG K		237.0	250.0	262.0	
10.HZ	DEG C		-56.15	-43.15	-31.15	
	DEG F		-69.07	-45.67	-24.07	
	DEG K		248.0	262.0	276.0	
100.HZ	DEG C		-45.15	-31.15	-17.15	
	DEG F		-49.27	-24.07	1.130	
	DEG K		260.0	276.0	295.0	
1000.HZ	DEG C		-33.15	-17.15	1.850	
	DEG F		-27.67	1.130	35.33	

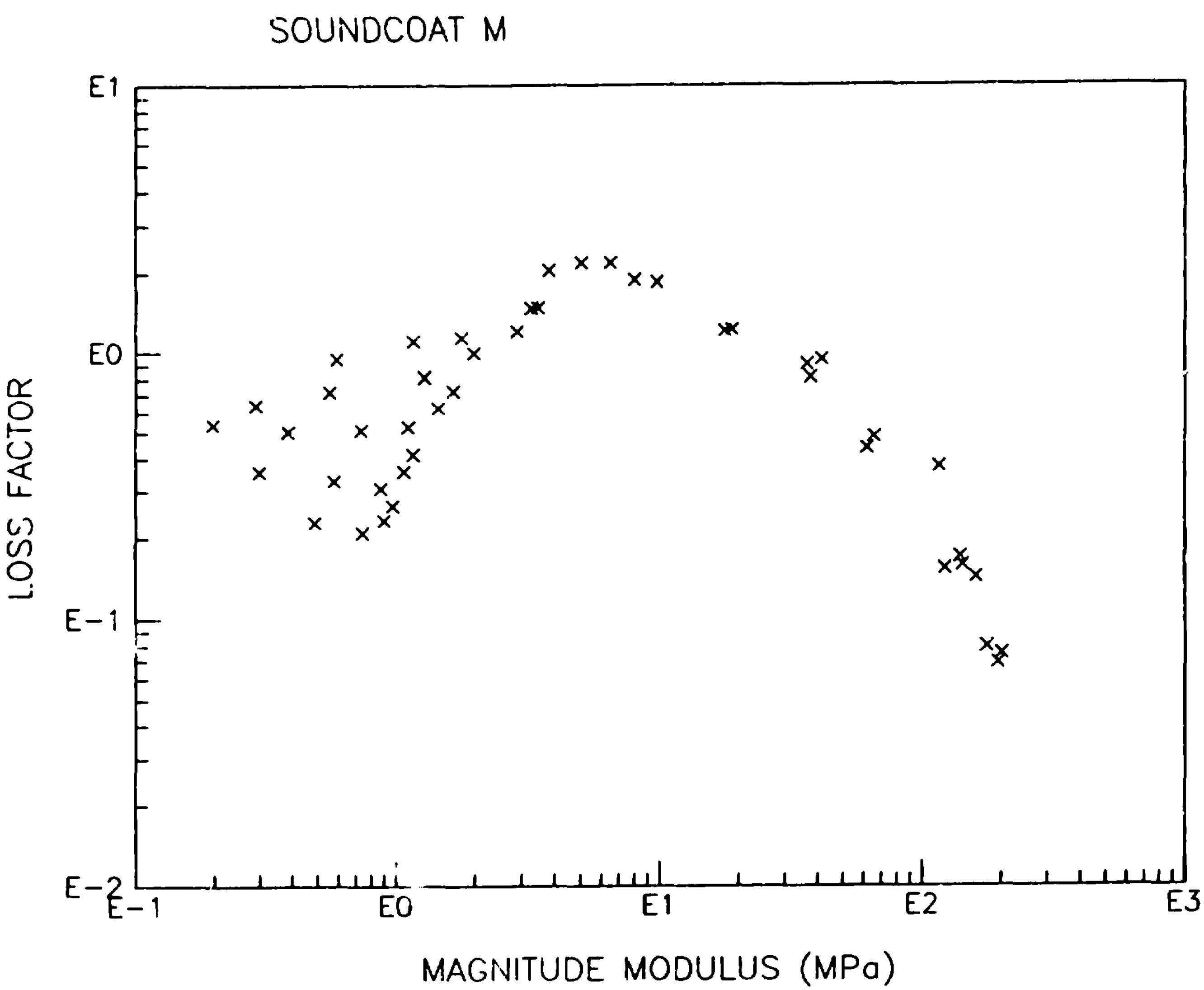

SOUNDCOAT M
SHEAR
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
Temperature (deg K)
REDUCED FREQUENCY (Hz)
FREQUENCY (Hz)
RE & IM MODULUS (MPa), LOSS FACTOR

SOUNDCOAT M

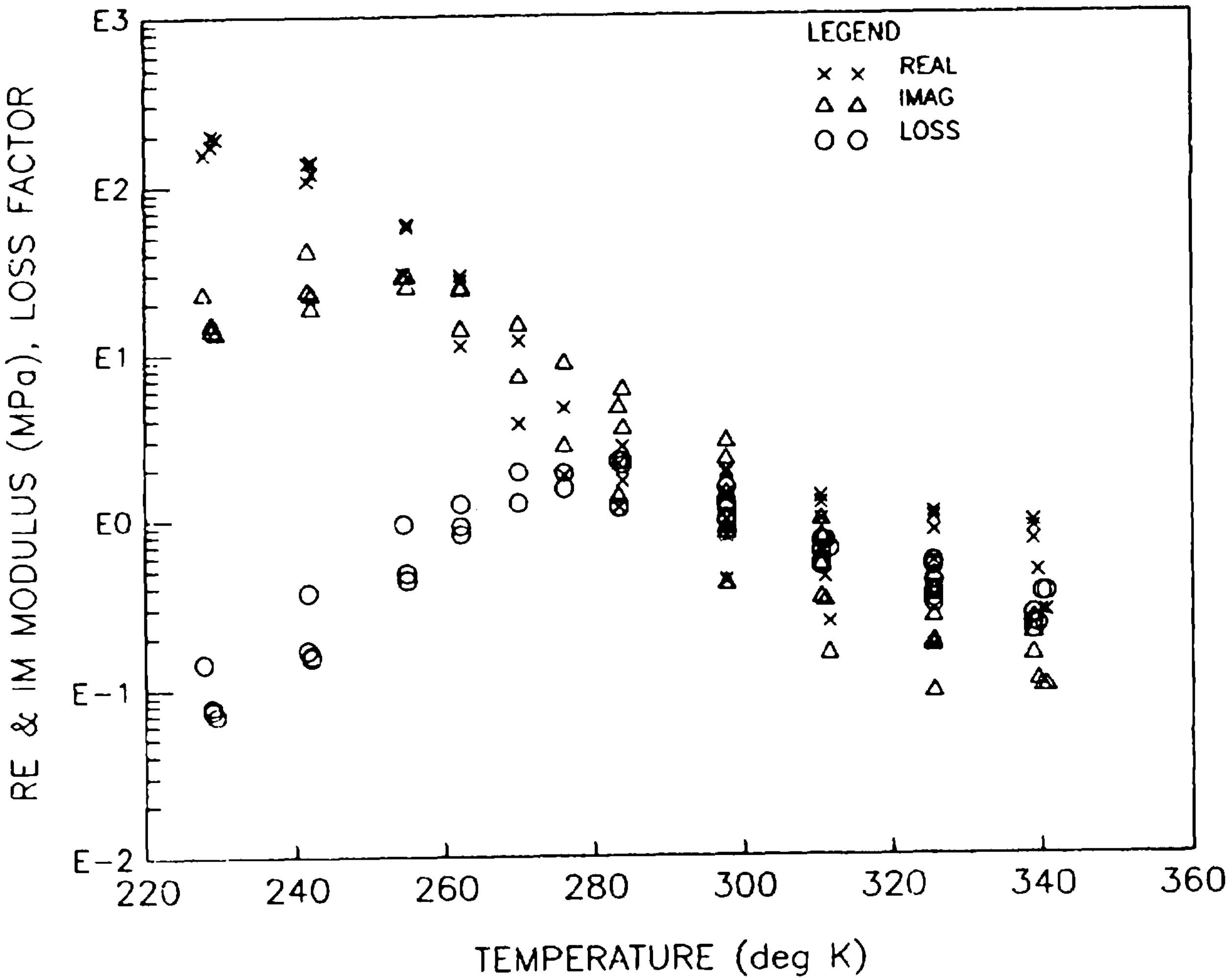
SHEAR



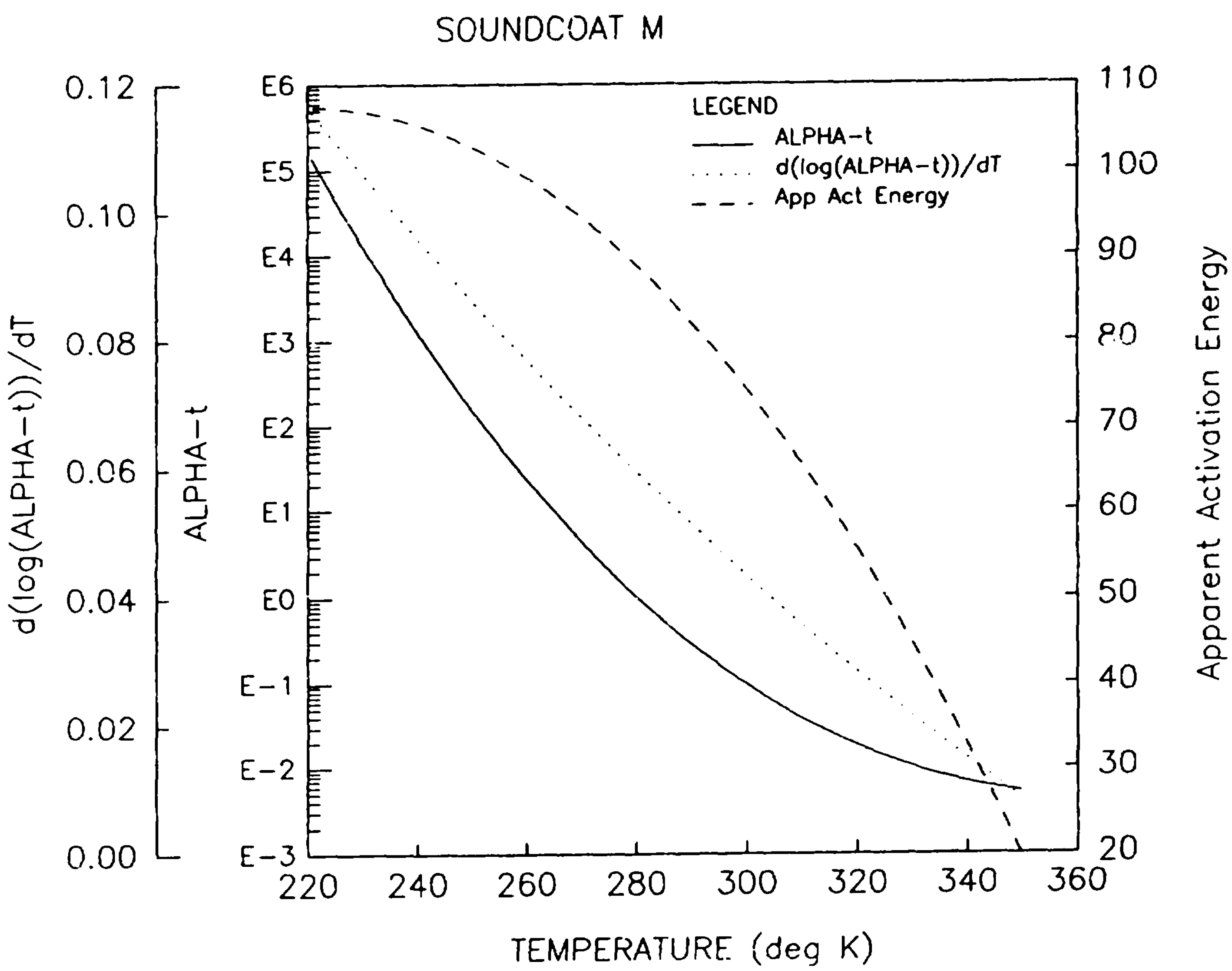

SOUNDCOAT M
FREQUENCY (Hz)
E2
E3
E4
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
TEMPERATURE (deg F)


SOUNDCOAT M
LOSS FACTOR
E1
E0
E−1
E−2
E−1
E0
E1
E2
E3
MAGNITUDE MODULUS (MPa)

SOUNDCOAT M



LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E-1
E-2
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)


SOUNDCOAT M
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.12
0.10
0.08
0.06
0.04
0.02
0.00
ALPHA-t
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
Apparent Activation Energy
110
100
90
80
70
60
50
40
30
20
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)

SOUNDCOAT M SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	260.0	220.0	350.0	0.5931E-01	0.1164	0.8304E-02

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.3882	250.0	0.3069E+06	0.7251	1.471	0.1532

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

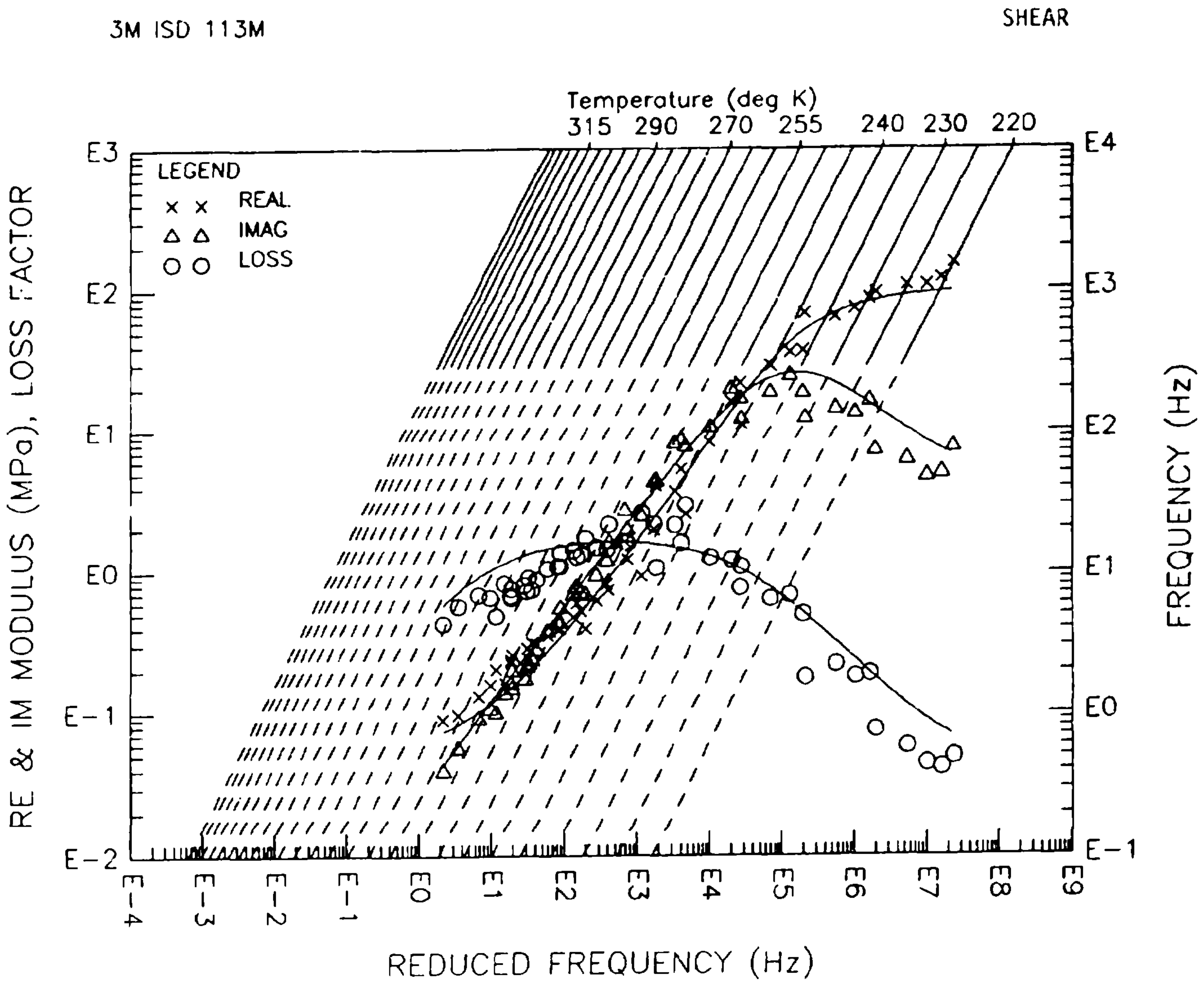
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
228.7	1816.	198.9	0.7467E-01	14.85
228.7	3434.	174.7	0.7903E-01	13.81
229.3	5529.	192.9	0.6892E-01	13.29
241.5	654.7	108.3	0.3736	40.46
241.5	1785.	137.5	0.1693	23.28
242.0	5360.	140.5	0.1581	22.21
254.3	632.0	29.98	0.9403	28.19
254.8	1704.	58.59	0.4809	28.32
254.8	3110.	56.24	0.4368	24.57
262.0	591.7	11.16	1.224	13.66
262.0	1619.	28.92	0.8134	23.52
262.0	2886.	26.85	0.9063	24.33
269.8	528.2	3.723	1.886	7.022
269.8	1468.	11.78	1.237	14.57
275.9	449.3	1.791	1.497	2.681
275.9	1288.	4.597	1.856	8.532
283.2	411.2	1.155	1.148	1.326
283.2	1130.	2.092	2.183	4.567
297.6	361.2	0.4260	0.9494	0.4044
297.6	1830.	C.9839	0.8166	0.8035
297.6	3006.	1.385	0.9987	1.383
297.6	4485.	1.824	1.211	2.209
297.6	6222.	1.898	1.499	2.845
311.5	342.0	0.2402	0.6432	0.1545
310.9	927.9	0.4441	0.7208	0.3201
310.4	1792.	0.6476	0.5128	0.3321
310.4	2955.	0.9770	0.5280	0.5159
310.4	4409.	1.213	0.6259	0.7592
310.4	6141.	1.320	0.7263	0.9587
325.4	333.9	0.1722	0.5388	0.9278E-01
325.4	914.0	0.3404	0.5037	0.1715
325.4	1775.	0.5426	0.3302	0.1792
325.4	2927.	0.8274	0.3077	0.2546
325.4	4371.	0.9991	0.3584	0.3581
325.4	6093.	1.063	0.4161	0.4423
340.4	903.7	0.2778	0.3564	0.9901E-01
339.3	1760.	0.4704	0.2287	0.1076
338.7	2907.	0.7191	0.2093	0.1505
338.7	4343.	0.8653	0.2335	0.2020
338.7	6057.	0.9322	0.2644	0.2465

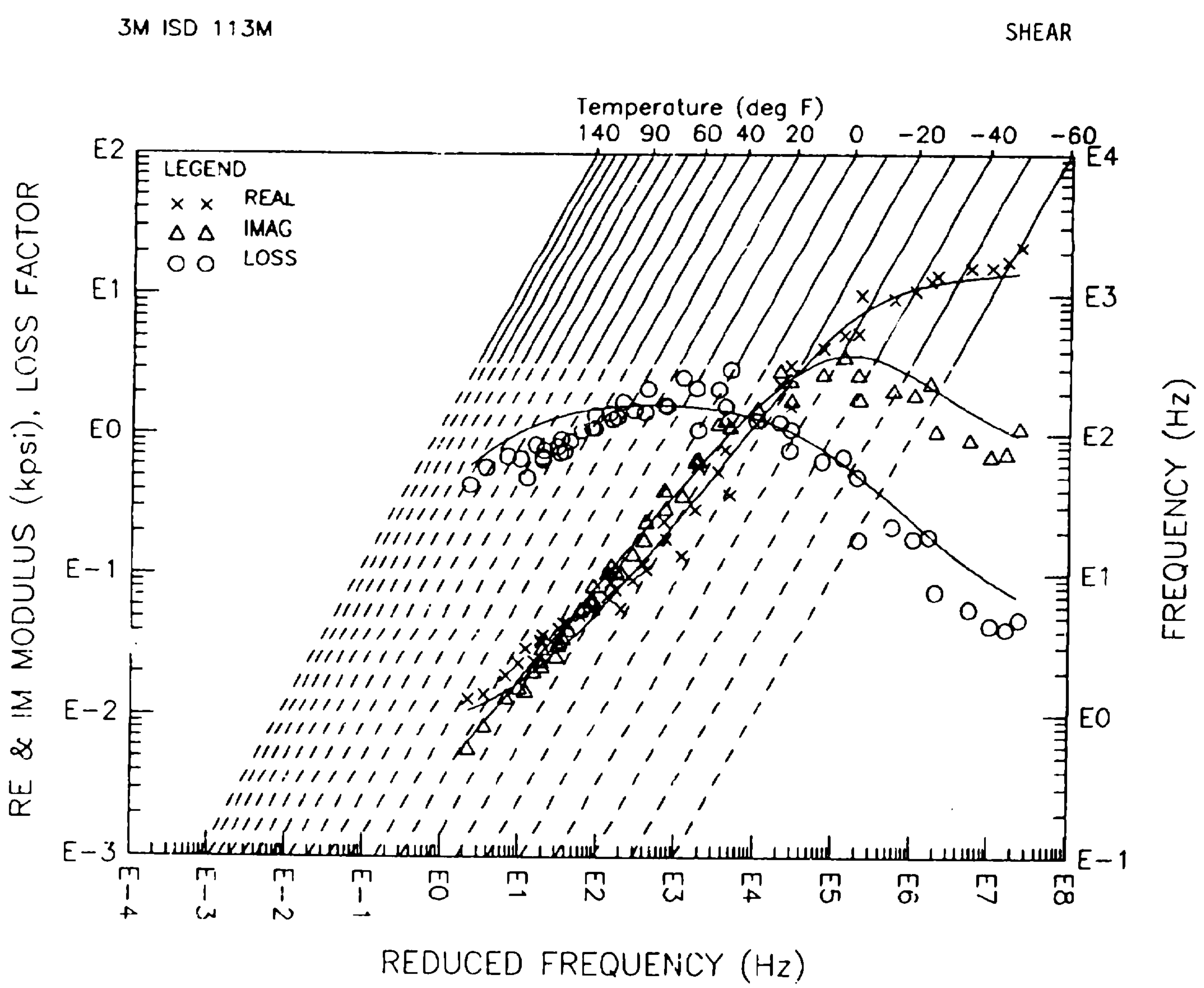
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
227.6	661.0	158.0	0.1429	22.58
283.7	1924.	1.658	2.049	3.397
283.7	3179.	2.679	2.183	5.848
297.6	965.6	0.7750	1.110	0.8602
339.8	903.7	0.2778	0.3564	0.9901E-01
242.0	3336.	120.2	0.1533	18.43

3M ISD 113M

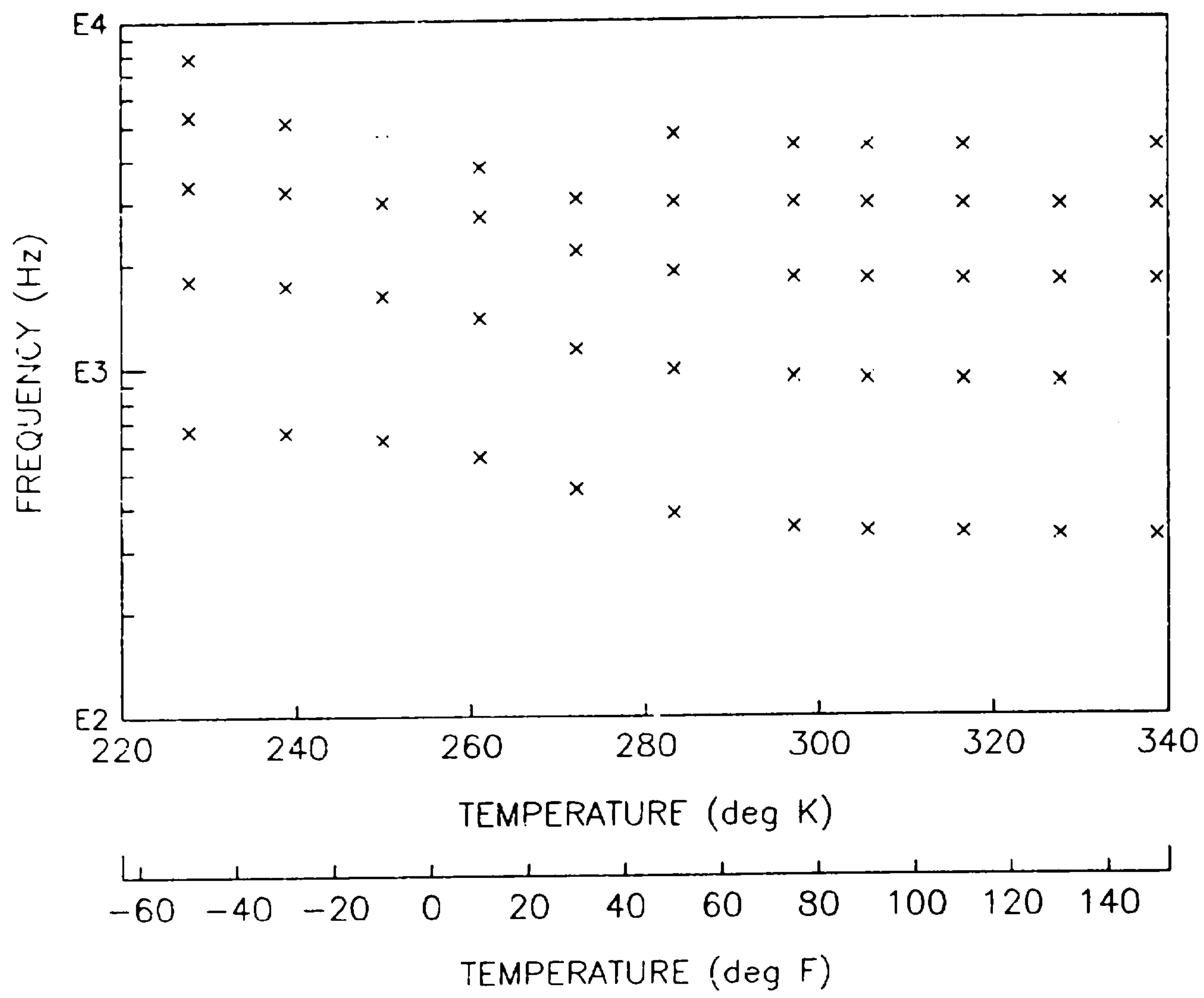
SHEAR

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.6879E-01	1.146	1.637	1.146	0.5835
MODULUS	MPA	96.69	14.84	1.029	0.1395	0.7368E-01
	PSI	0.1402E+05	2152.	149.2	20.23	10.69
	DEG K		229.0	249.0	272.0	
10.HZ	DEG C		-64.15	-44.15	-21.15	
	DEG F		-83.47	-47.47	-6.3[illegible]	
	DEG K		241.0	264.0	292.0	
100.HZ	DEG C		-52.15	-29.15	-1.150	
	DEG F		-61.87	-20.47	29.93	
	DEG K		254.0	281.0	321.0	
1000.HZ	DEG C		-39.15	-12.15	27.85	
	DEG F		-38.47	10.13	82.13	

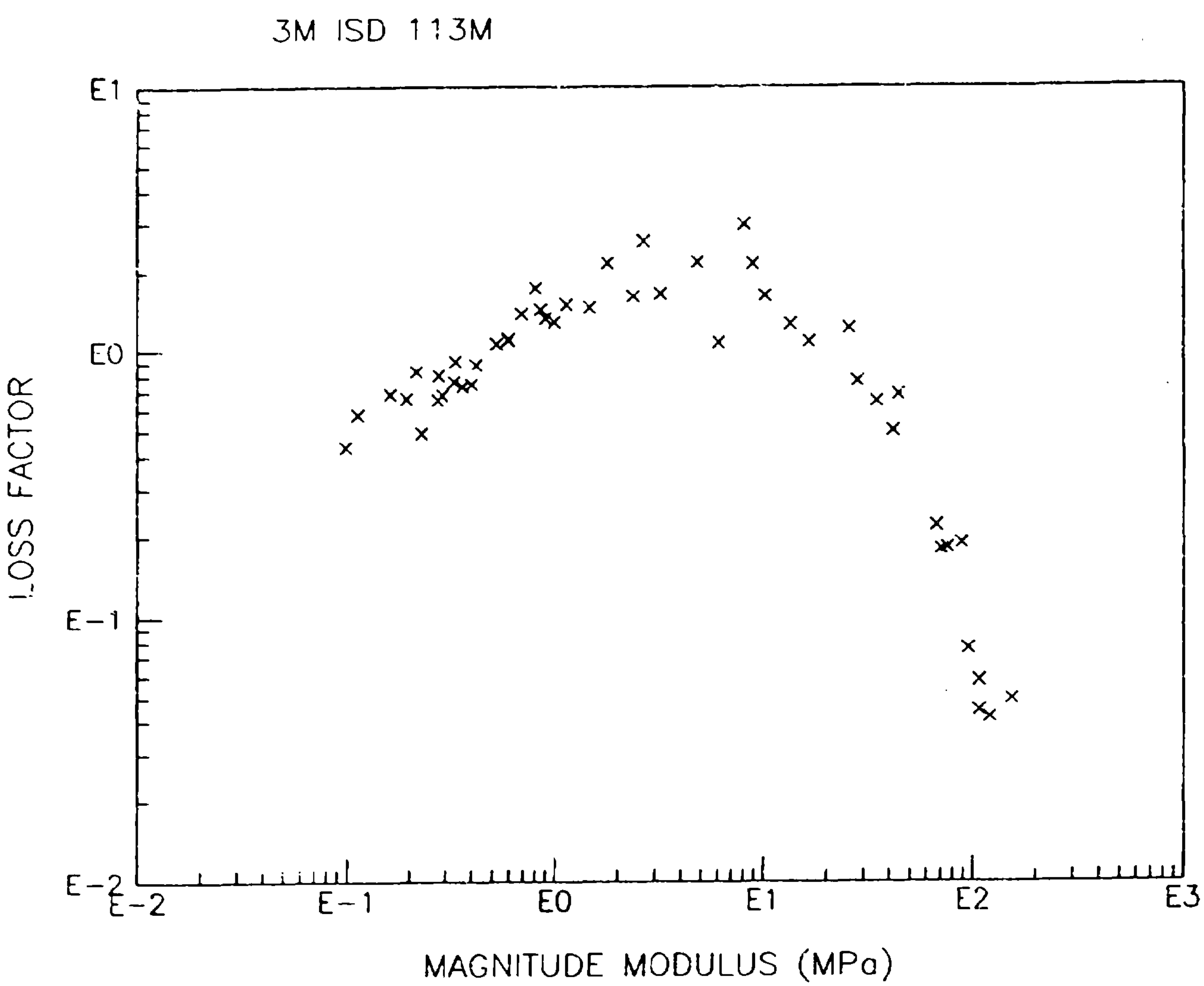

3M ISD 113M
SHEAR
Temperature (deg K)
315 290 270 255 240 230 220
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)
E3
E2
E1
E0
E−1
E−2
E4
E−4
E−3
E5
E6
E7
E8
E9


3M ISD 113M
SHEAR
Temperature (deg F)
140 90 60 40 20 0 -20 -40 -60
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E2
E1
E0
E-1
E-2
E-3
E-4 E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8
REDUCED FREQUENCY (Hz)
E4
E3
E2
E1
E0
E-1
FREQUENCY (Hz)

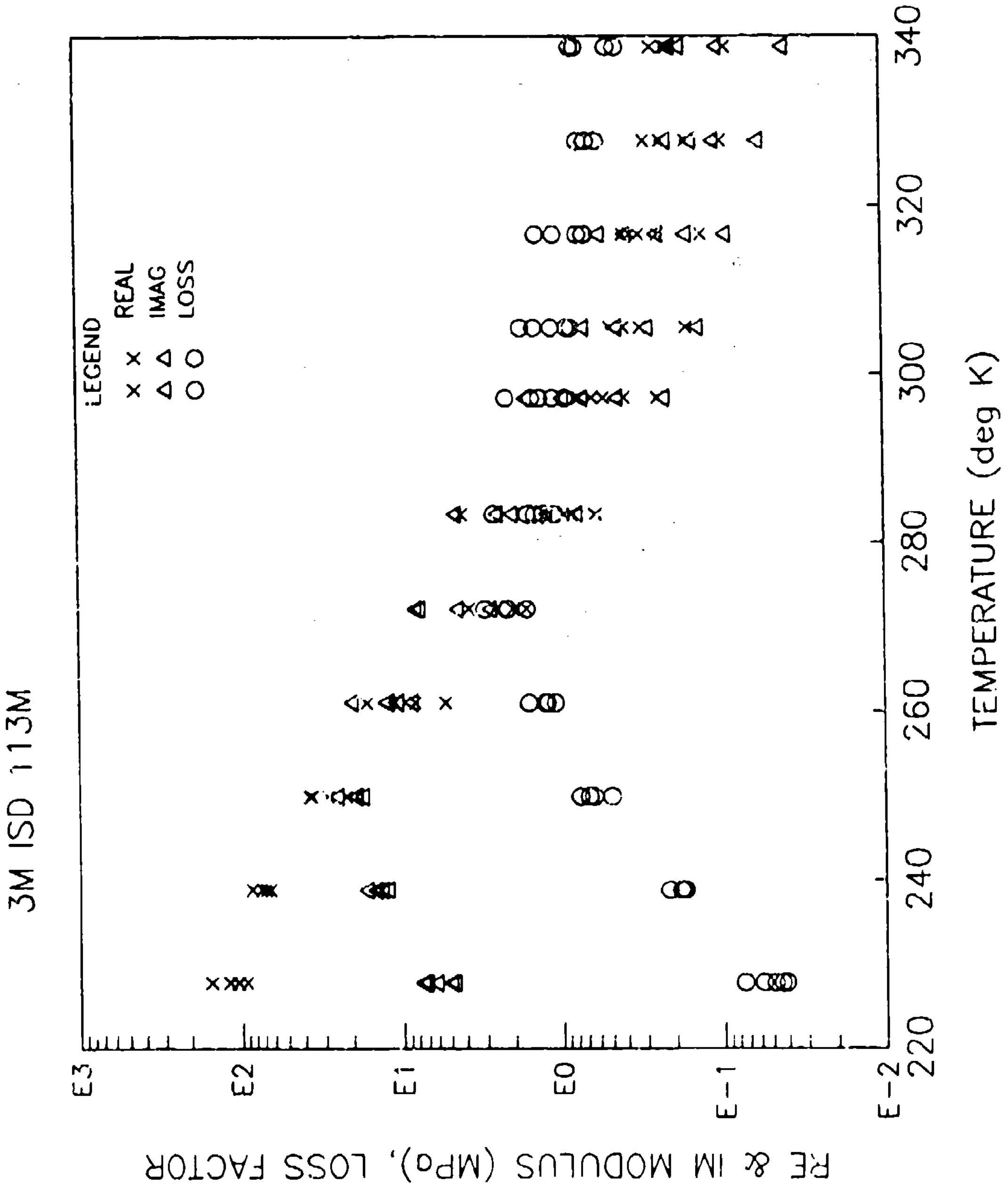
3M ISD 113M



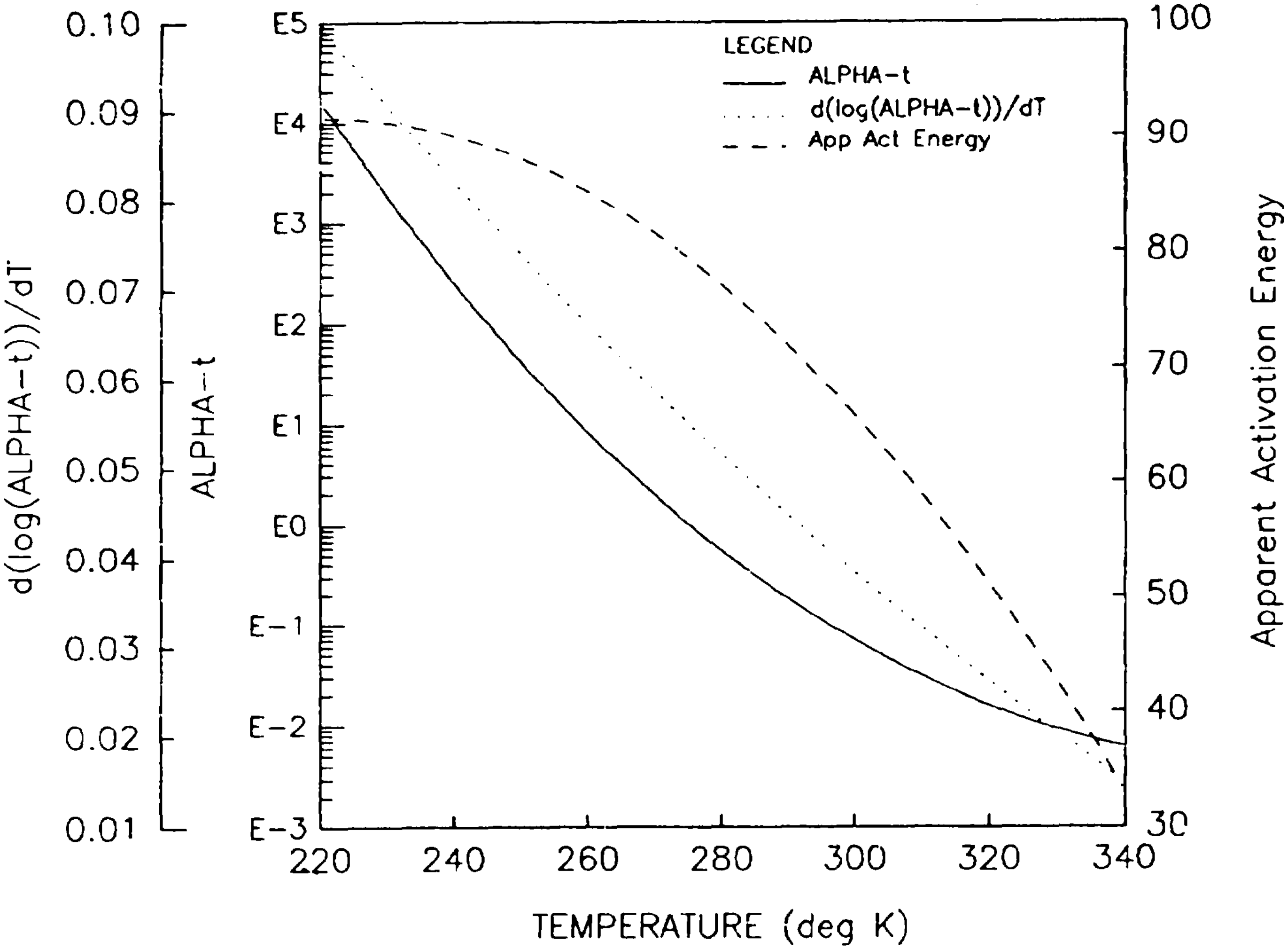
E4
E3
E2
FREQUENCY (Hz)
220
240
260
280
300
320
340
TEMPERATURE (deg K)
-60
-40
-20
0
20
40
60
80
100
120
140
TEMPERATURE (deg F)



3M ISD 113M
LOSS FACTOR
E1
E0
E−1
E−2
E−2
E−1
E0
E1
E2
E3
MAGNITUDE MODULUS (MPa)


3M ISD 113M
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
TEMPERATURE (deg K)
220
240
260
280
300
320
340

3M ISD 113M



LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
ALPHA-t
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
Apparent Activation Energy
100
90
80
70
60
50
40
30
220
240
260
280
300
320
340
TEMPERATURE (deg K)

3M ISD 113M SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	275.0	220.0	340.0	0.5500E-01	0.9926E-01	0.1500E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.5000E-01	175.0	0.3500E+06	0.6800	1.000	0.6000E-01

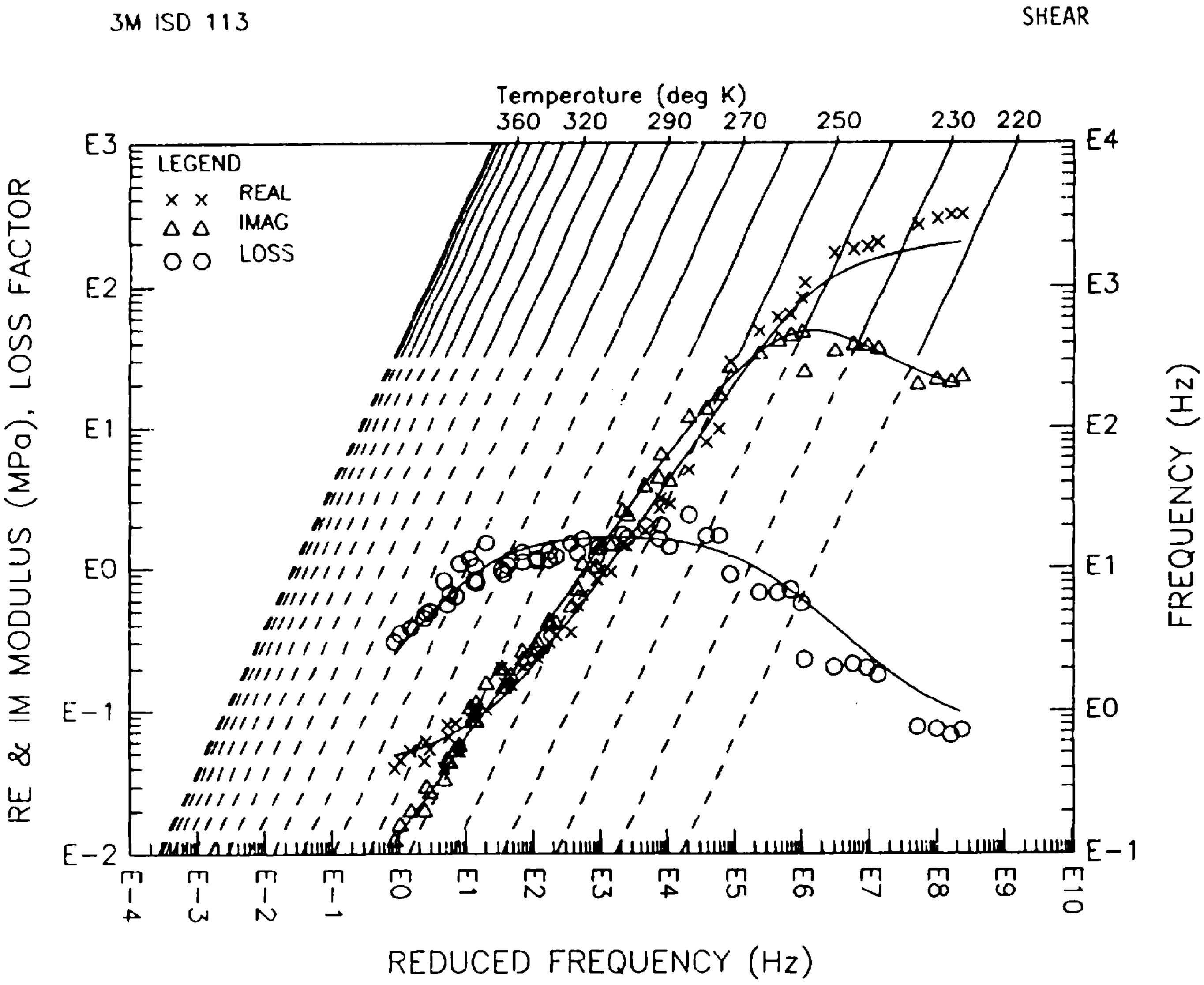
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
338.7	328.2	0.8970E-01	0.4344	0.3897E-01
338.7	1764.	0.2040	0.4896	0.9988E-01
338.7	2910.	0.2582	0.7613	0.1966
338.7	4331.	0.2131	0.8070	0.1720
327.6	330.1	0.9708E-01	0.5769	0.5601E-01
327.6	908.1	0.1601	0.6612	0.1059
327.6	1772.	0.2266	0.6541	0.1482
327.6	2922.	0.2870	0.7336	0.2105
316.5	334.9	0.1313	0.6874	0.9026E-01
316.5	918.7	0.2360	0.6804	0.1606
316.5	1786.	0.3147	0.7477	0.2353
316.5	2938.	0.3559	1.060	0.3773
316.5	4353.	0.4005	1.376	0.5511
305.4	339.7	0.1642	0.8324	0.1367
305.4	929.6	0.3102	0.8842	0.2743
305.4	1799.	0.3952	1.109	0.4383
305.4	2960.	0.4822	1.427	0.6881
305.4	4366.	0.3975	1.728	0.6869
297.0	348.7	0.2433	0.9119	0.2219
297.0	940.8	0.3983	1.096	0.4365
297.0	1817.	0.5337	1.329	0.7093
297.0	2980.	0.6247	1.494	0.9333
297.0	4410.	0.7447	2.152	1.603
283.2	383.1	0.6026	1.283	0.7731
283.2	990.1	0.8205	1.450	1.190
283.2	1895.	1.232	1.602	1.974
283.2	3005.	0.9384	2.602	2.442
283.2	4750.	4.113	1.072	4.409
272.0	460.3	1.642	1.634	2.683
272.0	1133.	1.982	2.177	4.315
272.0	2150.	3.739	2.139	7.998
272.0	3072.	2.546	2.969	7.559
260.9	555.0	5.307	1.605	8.518
260.9	1398.	8.288	1.261	10.45
260.9	2730.	16.12	1.217	19.62
260.9	3794.	11.06	1.086	12.01
249.8	621.2	21.93	0.7673	16.83
249.8	1623.	28.88	0.6443	18.61
249.8	3010.	35.97	0.6841	24.61
249.8	4551.	36.89	0.4996	18.43

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	mimag (MPA)
238.7	652.5	68.53	0.1786	12.24
238.7	1731.	64.64	0.2198	14.21
238.7	3226.	73.43	0.1807	13.27
238.7	5124.	85.57	0.1883	16.11
227.6	661.0	93.77	0.7550E-01	7.080
227.6	1791.	105.6	0.5778E-01	6.102
227.6	3350.	106.3	0.4421E-01	4.700
227.6	5341.	118.8	0.4147E-01	4.927
227.6	7839.	152.0	0.4921E-01	7.480

3M ISD 113 SHEAR

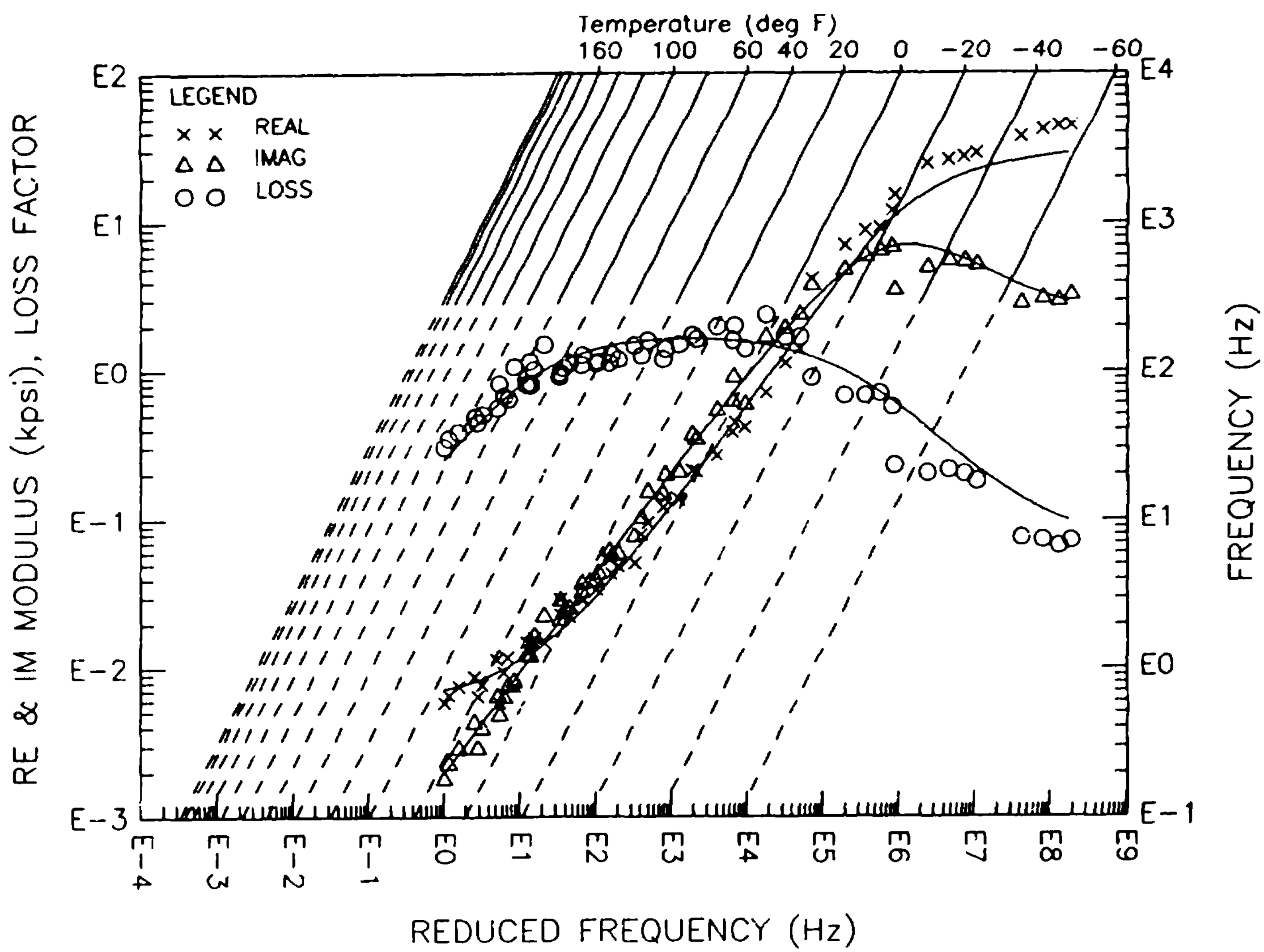
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.9724E-01	1.157	1.652	1.157	0.2502
MODULUS	MPA	201.0	24.87	1.210	0.1258	0.4874E-01
	PSI	0.2915E+05	3607.	175.5	18.25	7.069
10.HZ	DEG K		231.0	254.0	280.0	
	DEG C		-62.15	-39.15	-13.15	
	DEG F		-79.87	-38.47	8.330	
100.HZ	DEG K		243.0	269.0	300.0	
	DEG C		-50.15	-24.15	6.850	
	DEG F		-58.27	-11.47	44.33	
1000.HZ	DEG K		256.0	286.0	328.0	
	DEG C		-37.15	-7.150	34.85	
	DEG F		-34.87	19.13	94.73	

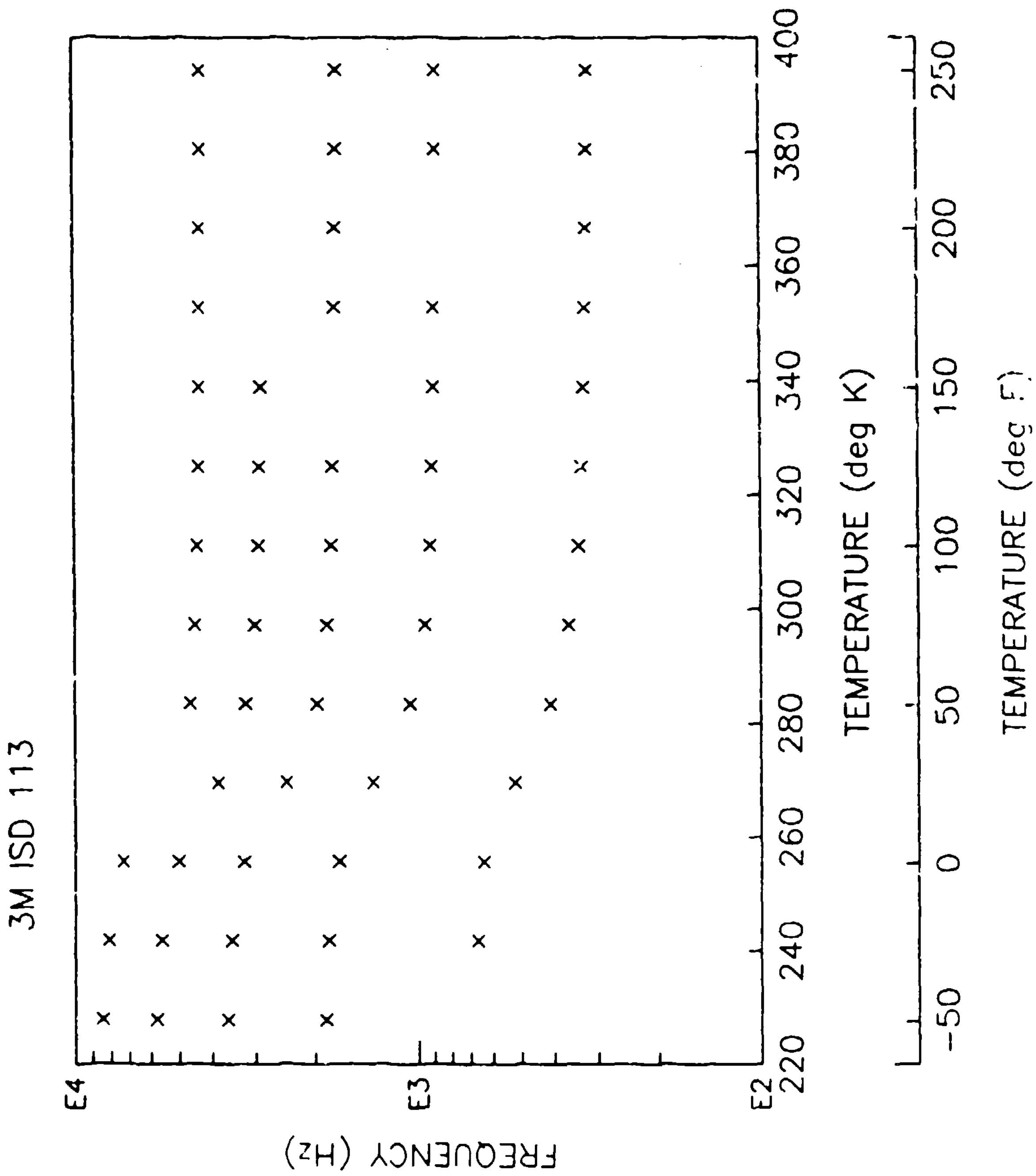


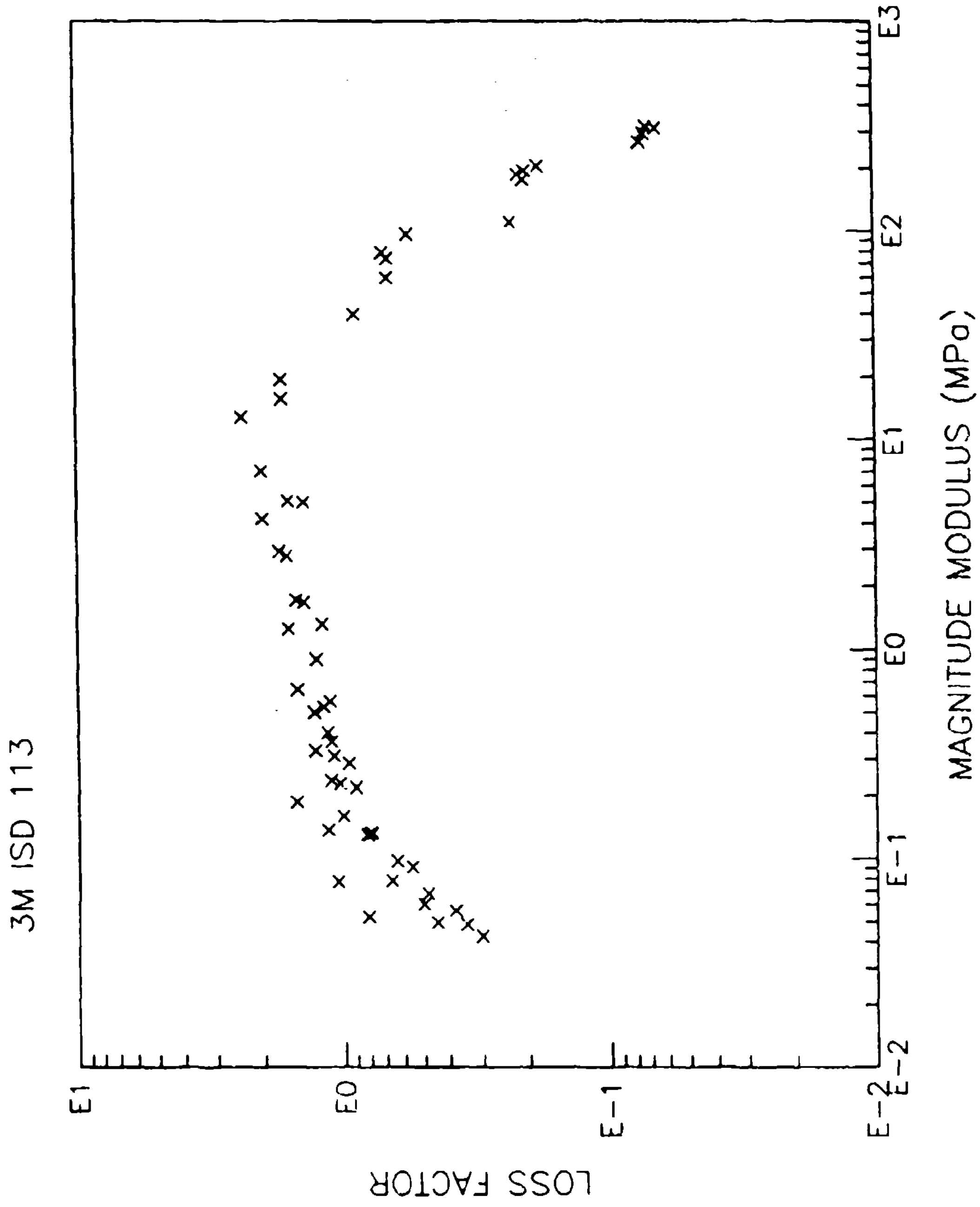
3M ISD 113
SHEAR
Temperature (deg K)
360 320 290 270 250 230 220
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
FREQUENCY (Hz)
E4
E3
E2
E1
E0
E−1
E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10
REDUCED FREQUENCY (Hz)

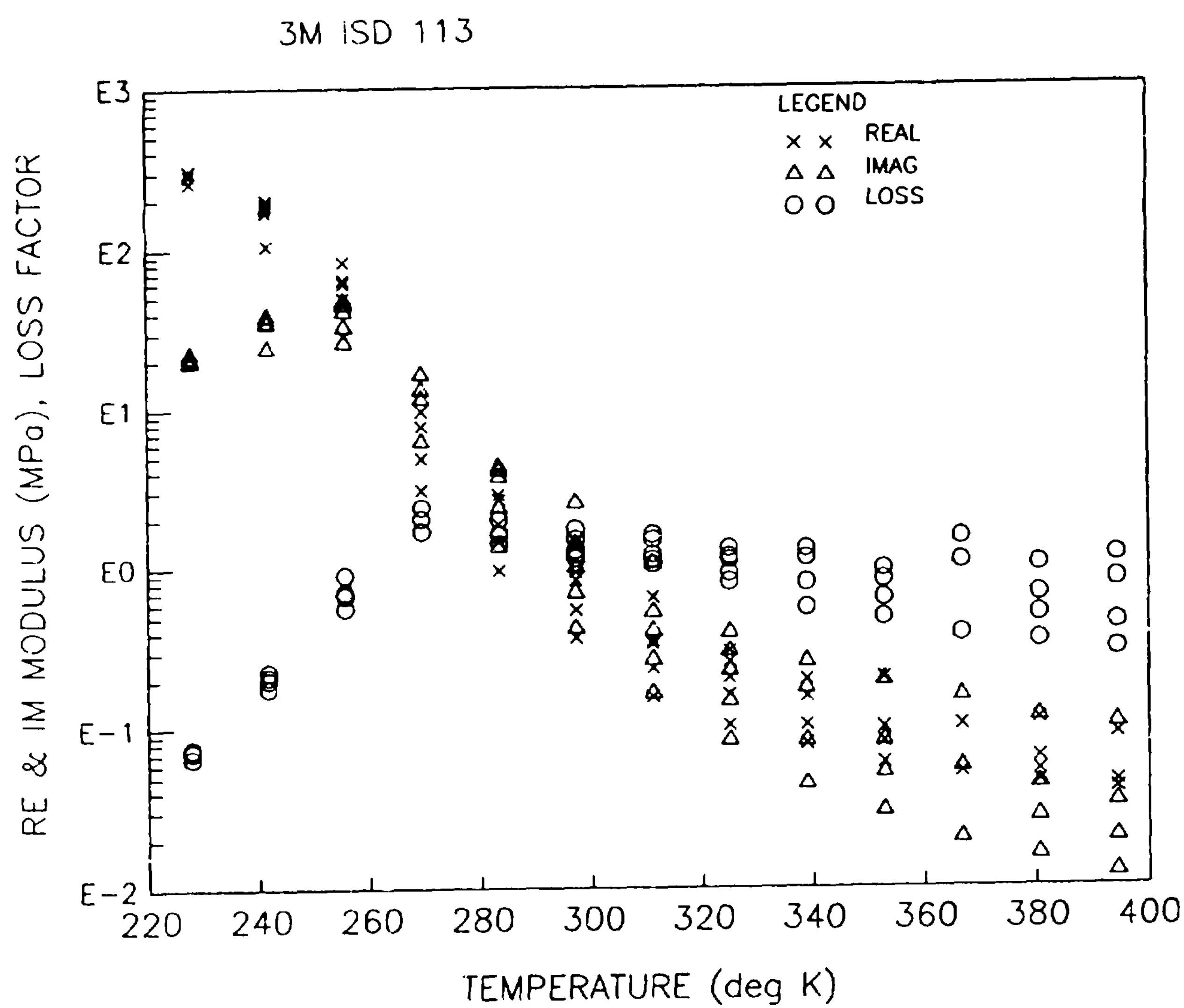
3M ISD 113

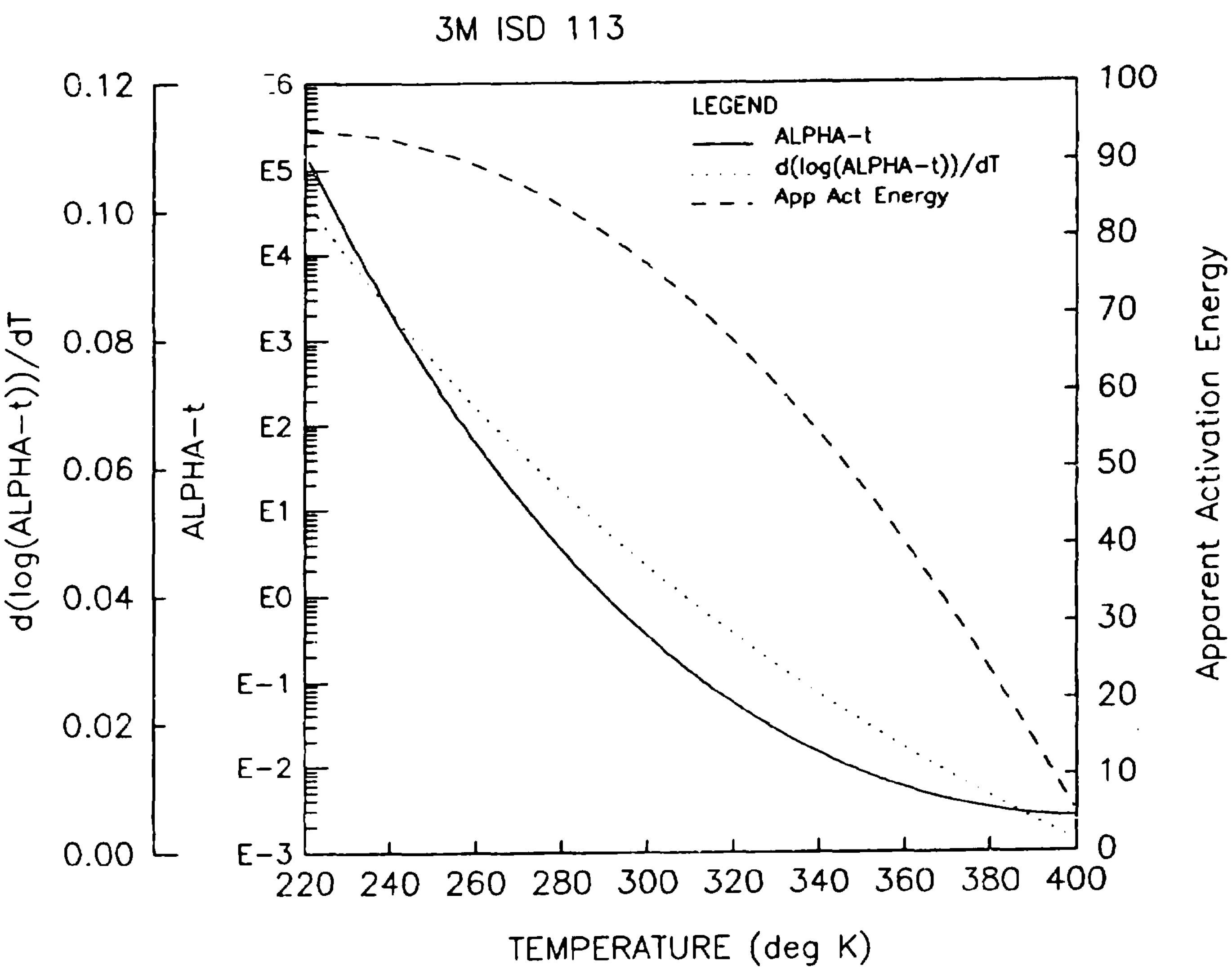
SHEAR




3M ISD 113
FREQUENCY (Hz)
E4
E3
E2
220
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)
-50
0
50
100
150
200
250
TEMPERATURE (deg F)


3M ISD 113
LOSS FACTOR
E1
E0
E−1
E−2
MAGNITUDE MODULUS (MPa)
E−2
E−1
E0
E1
E2
E3


3M ISD 113
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
220
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)


3M ISD 113
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.12
0.10
0.08
0.06
0.04
0.02
0.00
ALPHA-t
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
Apparent Activation Energy
100
90
80
70
60
50
40
30
20
10
0
220 240 260 280 300 320 340 360 380 400
TEMPERATURE (deg K)

3M ISD 113 SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	290.0	220.0	400.0	0.5016E-01	0.1018	0.1580E-02

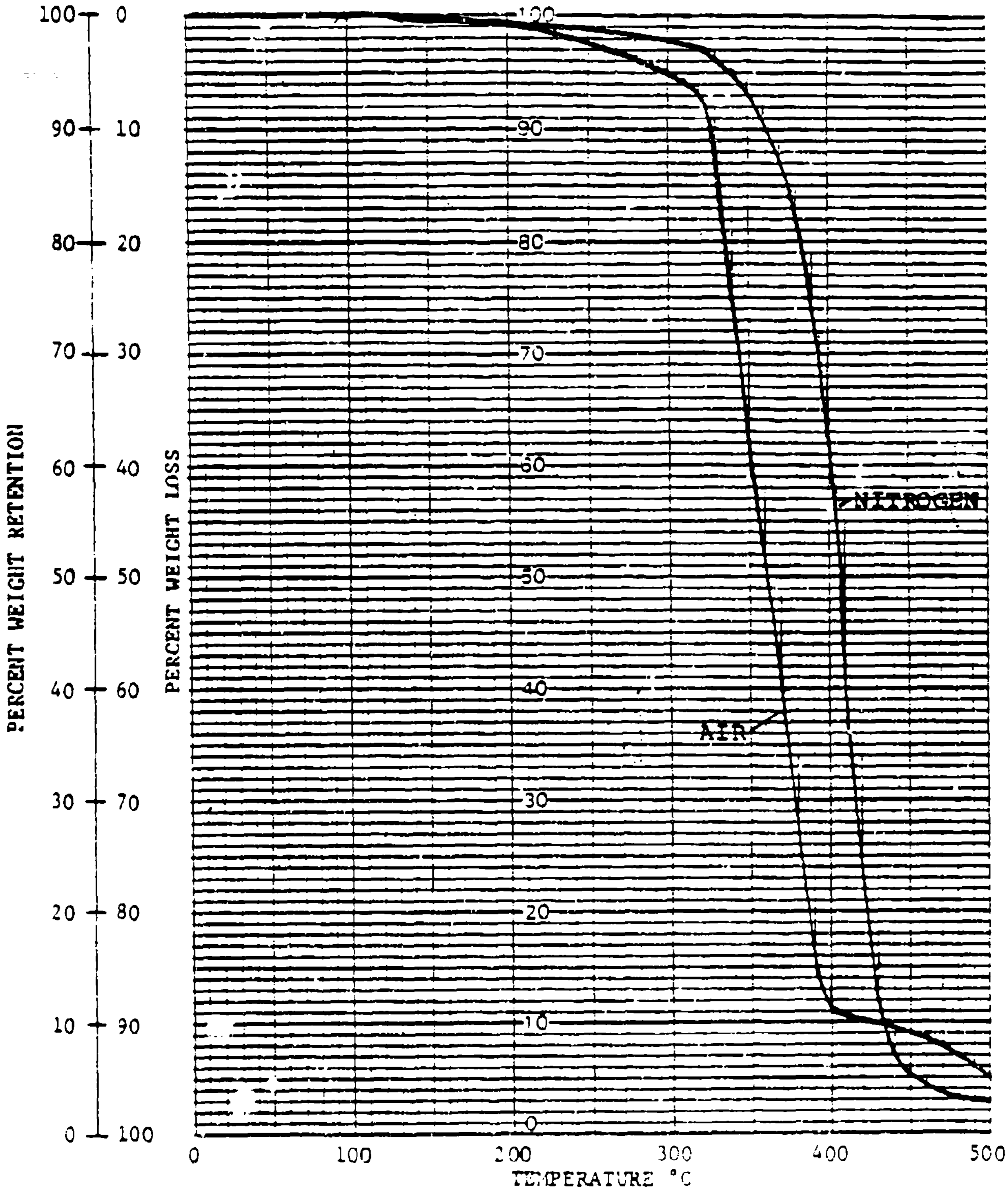
COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.4190E-01	499.0	0.4640E+07	0.6747	1.950	0.7850E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
227.6	1861.	261.1	0.7567E-01	19.76
227.6	3579.	289.1	0.7327E-01	21.18
227.6	5788.	307.7	0.6644E-01	20.44
227.6	8432.	310.6	0.7201E-01	22.37
241.5	663.2	106.0	0.2282	24.19
241.5	1828.	170.1	0.2031	34.55
241.5	3486.	179.8	0.2133	38.35
241.5	5591.	188.0	0.2006	37.71
241.5	8082.	199.3	0.1791	35.69
255.4	638.0	29.06	0.9018	26.21
255.4	1718.	48.73	0.6765	32.97
255.4	3225.	60.52	0.6751	40.86
255.4	6040.	63.59	0.7038	44.75
255.4	7310.	83.02	0.5670	47.07
269.3	520.0	3.080	2.018	6.215
269.3	1364.	4.874	2.382	11.61
269.3	2446.	7.833	1.692	13.25
269.3	3815.	9.736	1.694	16.49
283.2	409.1	0.9577	1.407	1.347
283.2	1055.	1.438	1.630	2.344
283.2	1967.	1.848	1.994	3.685
283.2	3188.	2.654	1.606	4.262
283.2	4631.	2.856	1.415	4.041
297.0	362.1	0.3696	1.135	0.4195
297.0	957.2	0.5474	1.275	0.6979
297.0	1845.	0.8329	1.204	1.003
297.0	3017.	0.9357	1.505	1.408
297.0	4496.	1.449	1.733	2.511
310.9	339.2	0.1565	1.044	0.1634
310.9	921.8	0.2376	1.123	0.2668
310.9	1790.	0.3370	1.200	0.4044
310.9	2938.	0.3541	1.494	0.5290
310.9	4405.	0.6554	1.602	1.050
324.8	331.1	0.1025	0.8045	0.8246E-01
324.8	908.8	0.1596	0.9092	0.1451
324.8	1769.	0.2054	1.101	0.2261
324.8	2914.	0.2577	1.160	0.2989
324.8	4347.	0.3014	1.299	0.3915
338.7	327.1	0.7860E-01	0.5595	0.4398E-01
338.7	899.5	0.1027	0.7950	0.8165E-01

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
338.7	2894.	0.1560	1.131	0.1783
338.7	4322.	0.1995	1.287	0.2568
352.6	323.5	0.6048E-01	0.4870	0.2945E-01
352.6	893.4	0.8088E-01	0.6403	0.5179E-01
352.6	1744.	0.9936E-01	0.8275	0.8222E-01
352.6	4305.	0.2030	0.9654	0.1960
366.5	321.1	0.5192E-01	0.3816	0.1981E-01
366.5	1735.	0.5208E-01	1.070	0.5573E-01
366.5	4283.	0.1018	1.611	0.1638
380.4	319.3	0.4514E-01	0.3467	0.1565E-01
380.4	884.1	0.5329E-01	0.5048	0.2690E-01
380.4	1728.	0.6437E-01	0.6715	0.4322E-01
380.4	4266	0.1104	1.019	0.1125
394.3	317.6	0.4004E-01	0.3045	0.1219E-01
394.3	879.5	0.4462E-01	0.4461	0.1990E-01
394.3	1719.	0.4025E-01	0.8175	0.3290E-01
394.3	4246.	0.8860E-01	1.160	0.1028



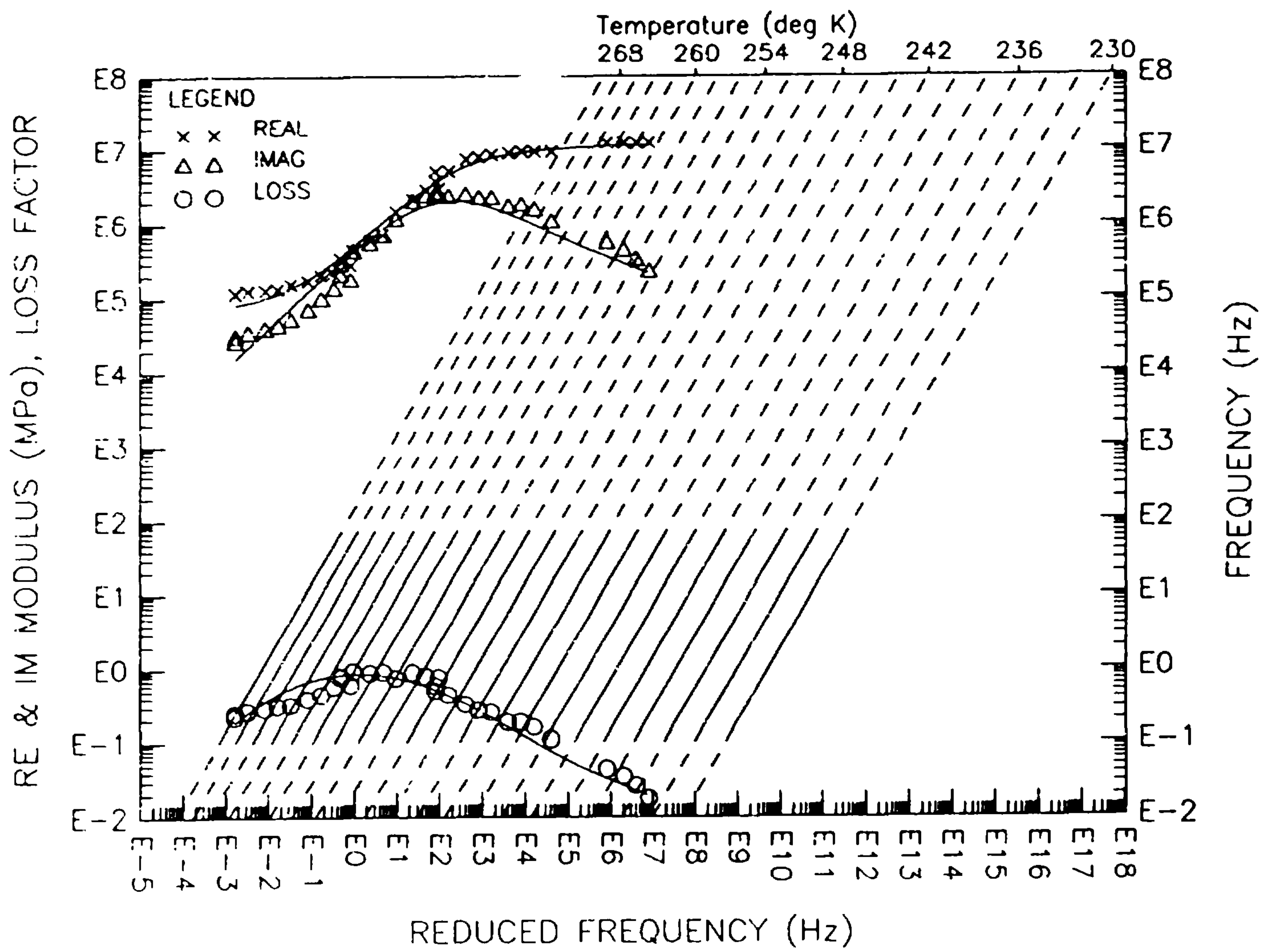
TGA of 3M Company's ISD 113.

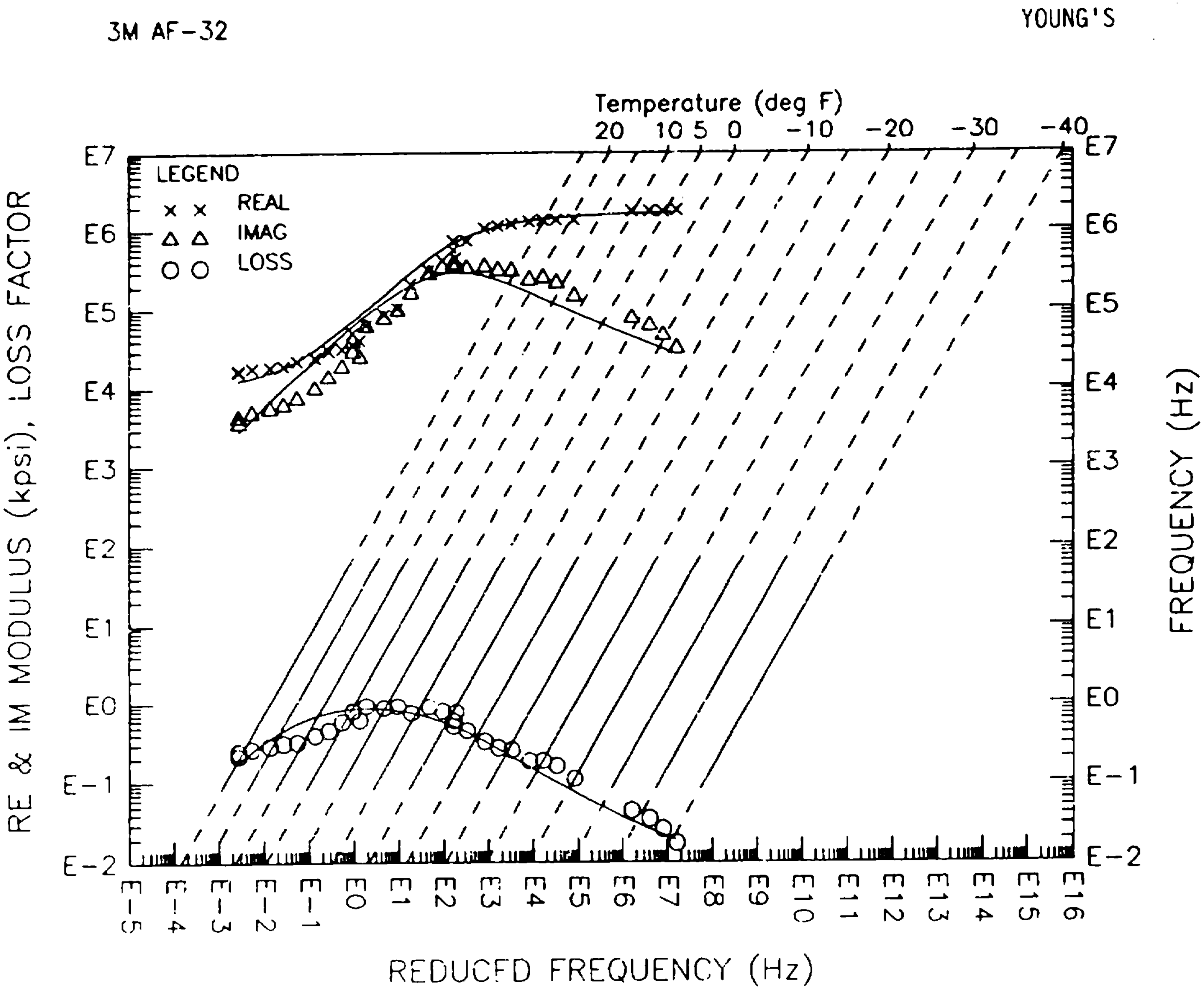
3M AF-32 YOUNG'S

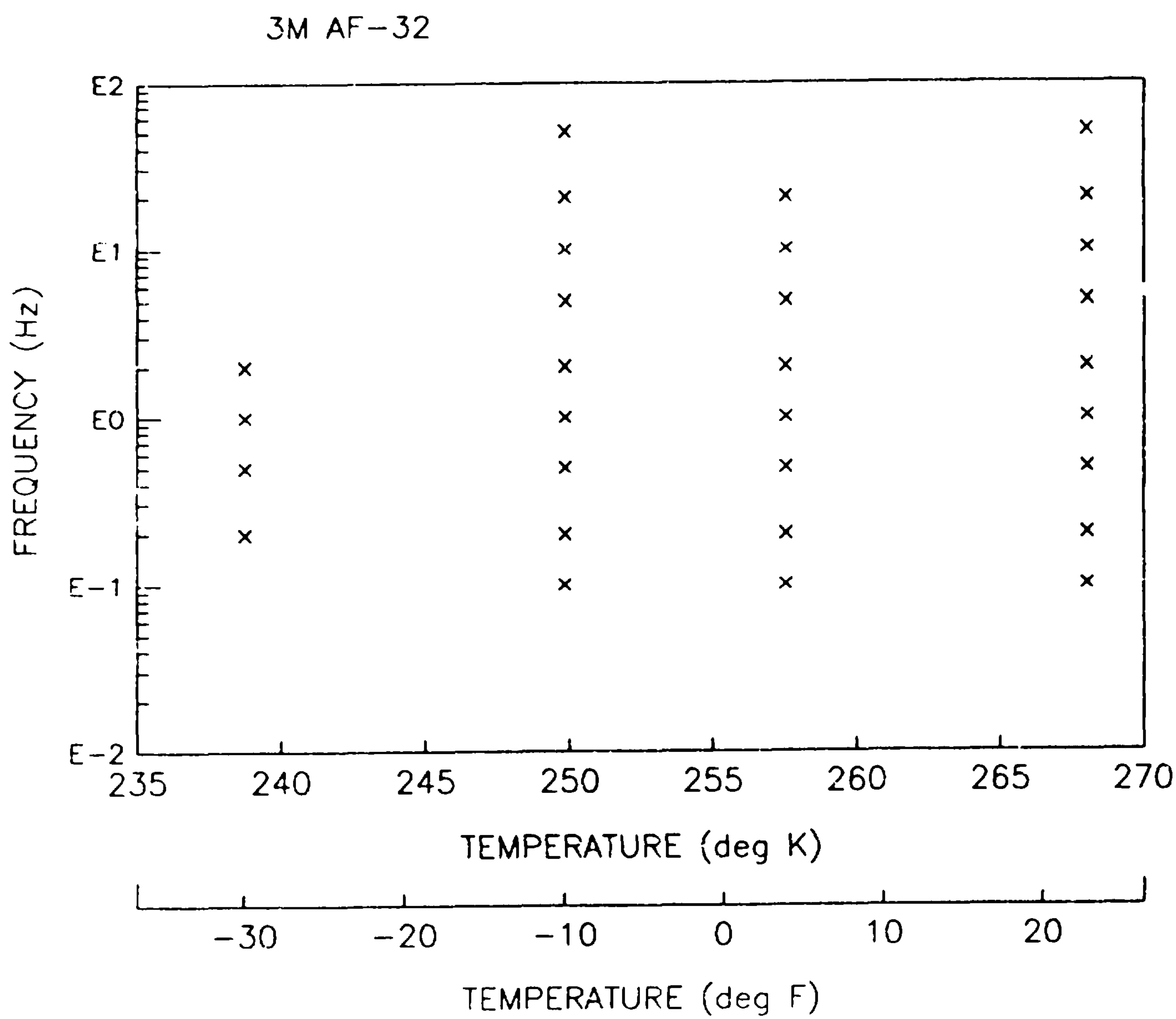
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1909E-01	0.6044	0.8634	0.6044	0.1839
MODULUS	MPA	0.1141E+08	0.3424E+07	0.5471E+06	0.1725E+06	0.8323E+05
	PSI	0.1555E+10	0.4966E+09	0.7935E+08	0.2501E+08	0.1207E+08
	DEG K		257.0	264.0	270.0	
10.HZ	DEG C		-36.15	-29.15	-23.15	
	DEG F		-33.07	-20.47	-9.670	
	DEG K		261.0	269.0	270.0	
100.HZ	DEG C		-32.15	-24.15	-23.15	
	DEG F		-25.87	-11.47	-9.670	
	DEG K		266.0	270.0	0.0000E+00	
1000.HZ	DEG C		-27.15	-23.15	-293.1	
	DEG F		-16.87	-9.670	-495.7	

3M AF-32

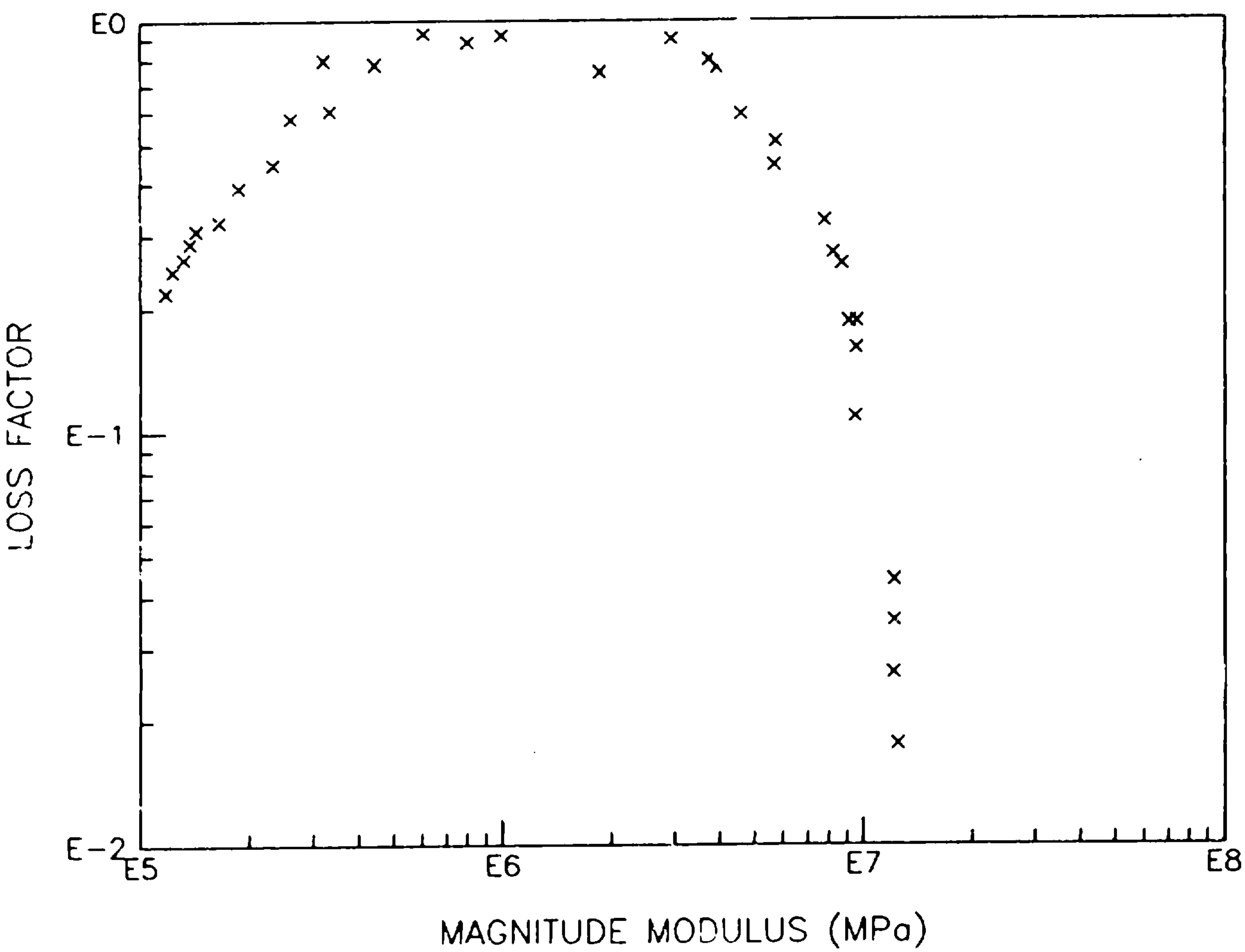
YOUNG'S



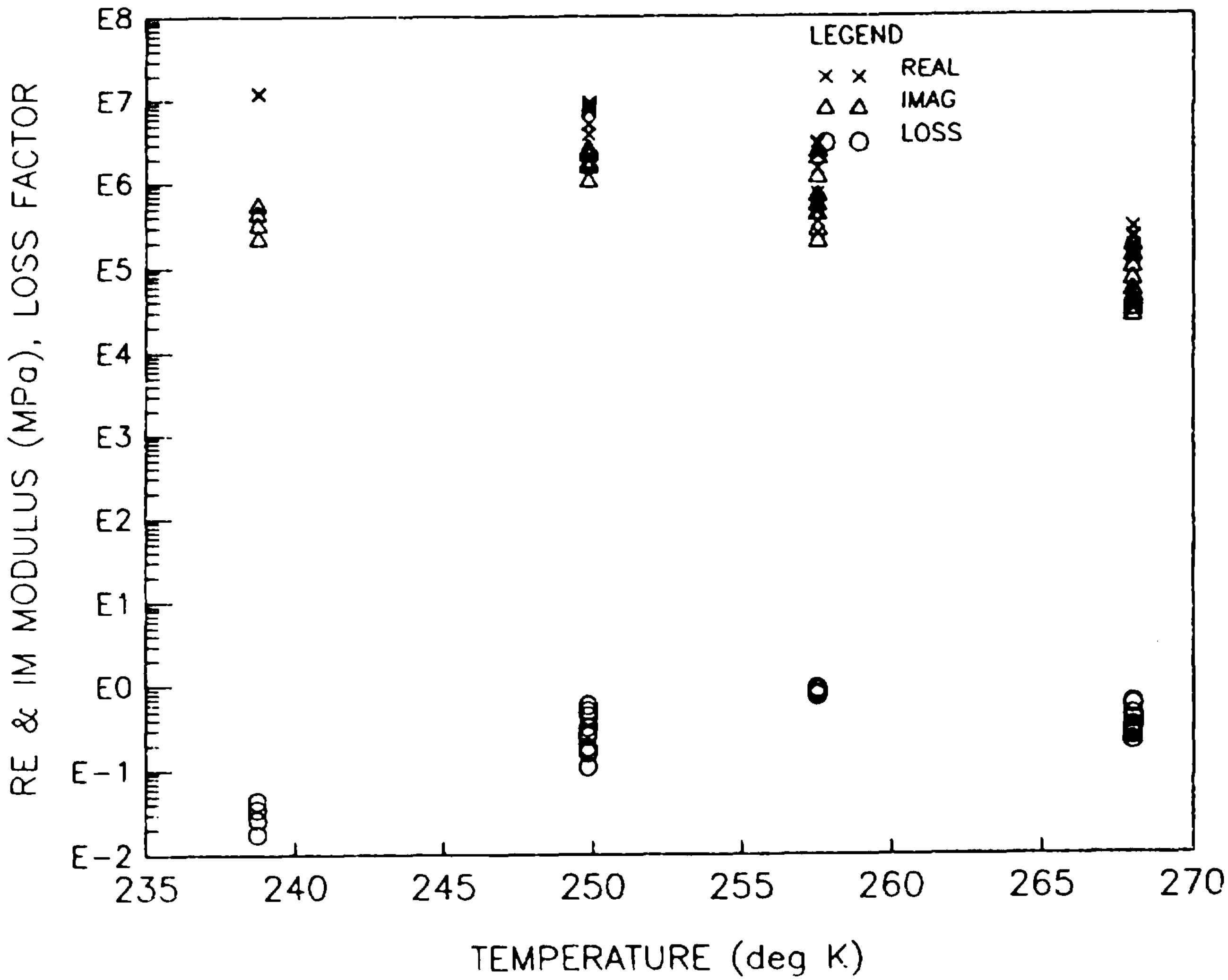

3M AF-32
YOUNG'S
Temperature (deg F)
20
10 5 0
-10
-20
-30
-40
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-5
E-4
E-3
E-2
E-1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
E15
E16
REDUCED FREQUENCY (Hz)
FREQUENCY (Hz)


3M AF-32
FREQUENCY (Hz)
E2
E1
E0
E-1
E-2
235
240
245
250
255
260
265
270
TEMPERATURE (deg K)
-30
-20
-10
0
10
20
TEMPERATURE (deg F)

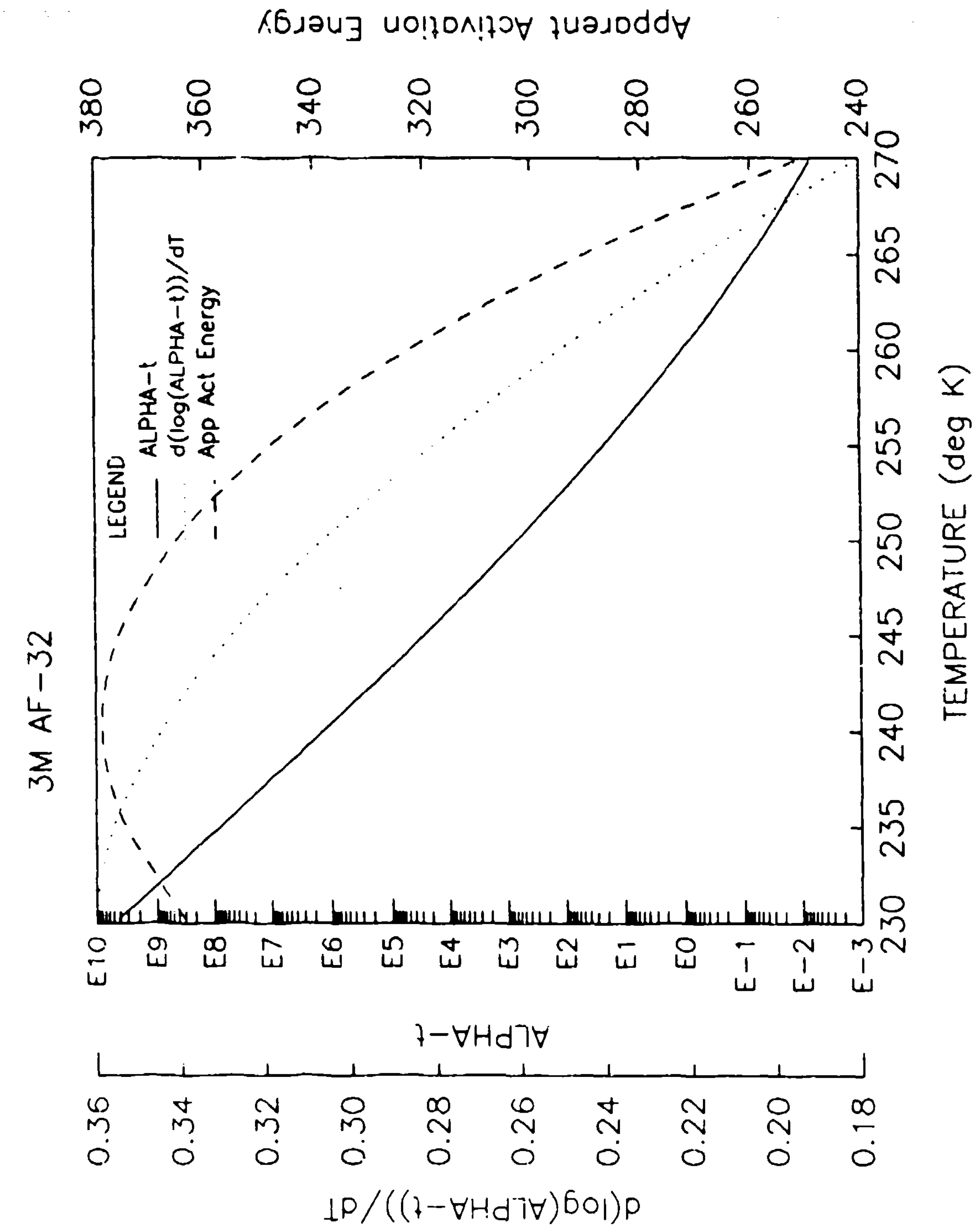
3M AF-32



3M AF-32



LEGEND
REAL
IMAG
LOSS
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
235
240
245
250
255
260
265
270
RE & IM MODULUS (MPa), LOSS FACTOR
TEMPERATURE (deg K)


3M AF-32
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
230
235
240
245
250
255
260
265
270
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
ALPHA-t
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
d(log(ALPHA-t))/dT
380
360
340
320
300
280
260
240
Apparent Activation Energy

3M AF-32 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	260.0	230.0	270.0	0.2500	0.3600	0.1800

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.7000E+05	0.1200E+08	170.0	0.5500	0.5000	0.2000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

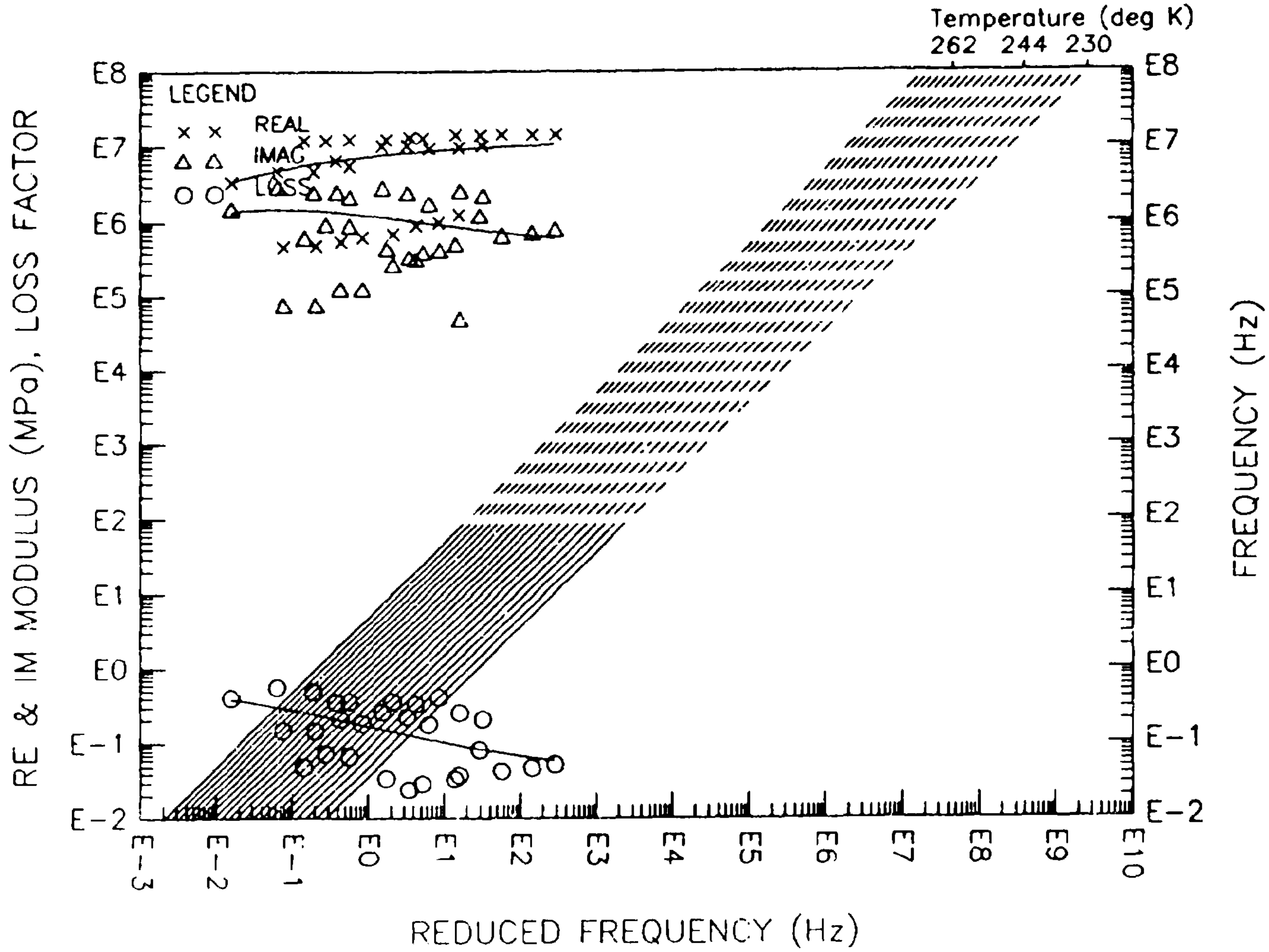
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
268.0	0.1000	0.1144E+06	0.2180	0.2494E+05
268.0	0.1000	0.1185E+06	0.2457	0.2912E+05
268.0	0.2000	0.1268E+06	0.2631	0.3336E+05
268.0	0.5000	0.1309E+06	0.2870	0.3757E+05
257.5	0.1000	0.2488E+06	0.7990	0.1988E+06
257.5	0.1000	0.3466E+06	0.7827	0.2713E+06
257.5	0.2000	0.4405E+06	0.9271	0.4084E+06
257.5	0.5000	0.5975E+06	0.8803	0.5260E+06
249.8	0.1000	0.3932E+07	0.5916	0.2326E+07
249.8	0.1000	0.5080E+07	0.5071	0.2576E+07
249.8	0.2000	0.5161E+07	0.4448	0.2296E+07
249.8	0.5000	0.7391E+07	0.3246	0.2399E+07
268.0	0.2000	0.1268E+06	0.2631	0.3336E+05
268.0	0.5000	0.1309E+06	0.2870	0.3757E+05
268.0	1.000	0.1351E+06	0.3095	0.4181E+05
268.0	2.000	0.1559E+06	0.3236	0.5046E+05
268.0	5.000	0.1727E+06	0.3918	0.6766E+05
268.0	10.00	0.2106E+06	0.4470	0.9414E+05
268.0	20.00	0.2233E+06	0.5792	0.1293E+06
257.5	0.2000	0.4405E+06	0.9271	0.4084E+06
257.5	0.5000	0.5975E+06	0.8803	0.5260E+06
257.5	1.000	0.7281E+06	0.9153	0.6664E+06
257.5	2.000	0.1478E+07	0.7496	0.1108E+07
257.5	5.000	0.2168E+07	0.9001	0.1951E+07
257.5	10.00	0.2902E+07	0.7993	0.2320E+07
257.5	20.00	0.3097E+07	0.7692	0.2382E+07
249.8	0.2000	0.5161E+07	0.4448	0.2296E+07
249.8	0.5000	0.7391E+07	0.3246	0.2399E+07
249.8	1.000	0.7902E+07	0.2711	0.2142E+07
249.8	2.000	0.8384E+07	0.2540	0.2130E+07
249.8	5.000	0.8895E+07	0.1855	0.1650E+07
249.8	10.00	0.9370E+07	0.1862	0.1745E+07
249.8	20.00	0.9370E+07	0.1605	0.1504E+07
249.8	50.00	0.9370E+07	0.1095	0.1026E+07
238.7	0.2000	0.1209E+08	0.4370E-01	0.5283E+06
238.7	0.5000	0.1209E+08	0.3490E-01	0.4219E+06
238.7	1.000	0.1199E+08	0.2620E-01	0.3141E+06
238.7	2.000	0.1236E+08	0.1760E-01	0.2175E+06
268.0	50.00	0.2830E+06	0.6050	0.1712E+06

3M AF-30 YOUNG'S

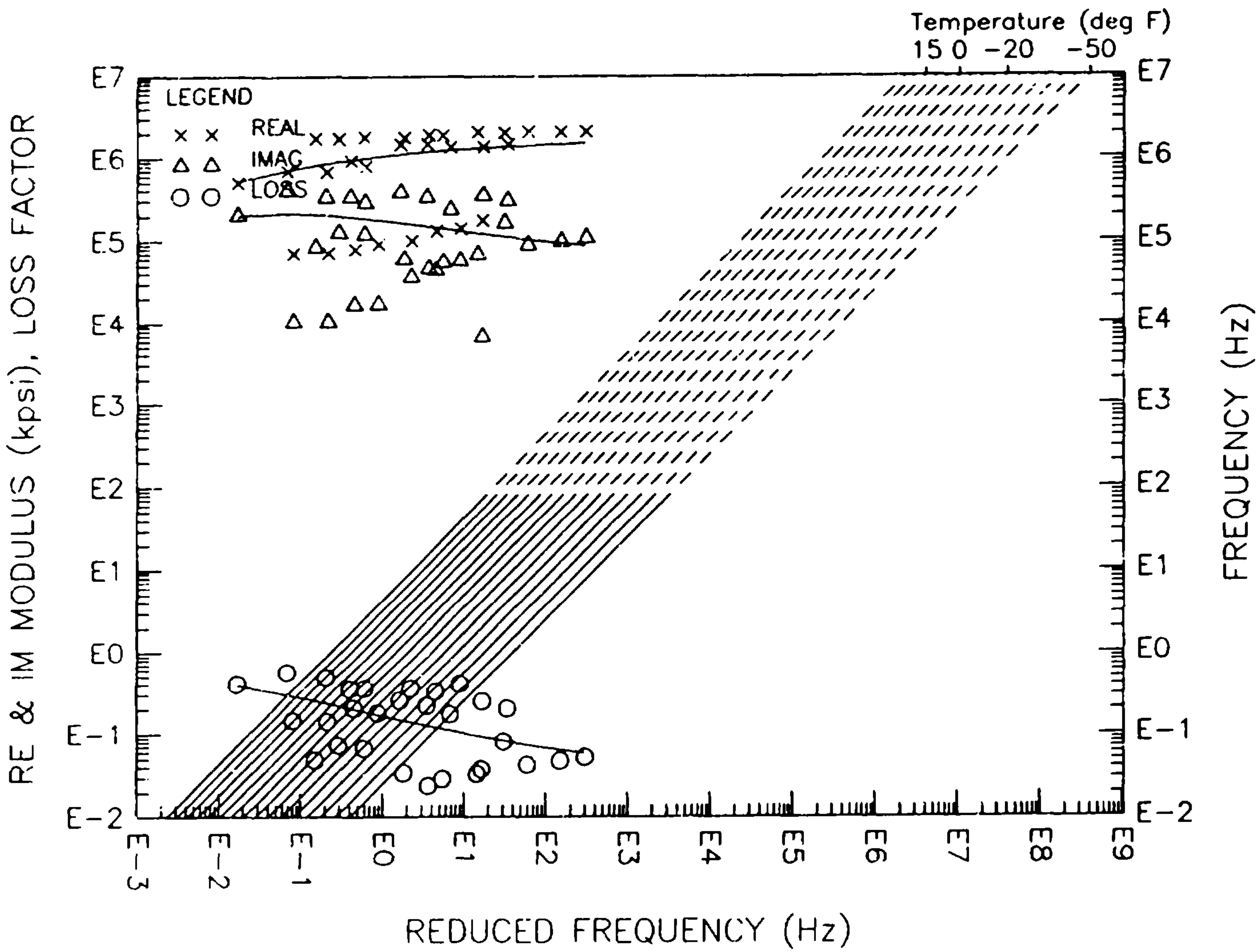
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.5891E-01	0.2745	0.3922	0.2745	0.3922
MODULUS	MPA	0.1048E+08	0.7913E+07	0.7913E+07	0.0000E+00	0.3500E+07
	PSI	0.1520E+10	0.1148E+10	0.1148E+10	0.0000E+00	0.5077E+09
10.HZ	DEG K		270.0	270.0	0.0000E+00	
	DEG C		-23.15	-23.15	-293.1	
	DEG F		-9.670	-9.670	-495.7	
100.HZ	DEG K		270.0	270.0	0.0000E+00	
	DEG C		-23.15	-23.15	-293.1	
	DEG F		-9.670	-9.670	-495.7	
1000.HZ	DEG K		270.0	270.0	0.0000E+00	
	DEG C		-23.15	-23.15	-293.1	
	DEG F		-9.670	-9.670	-495.7	

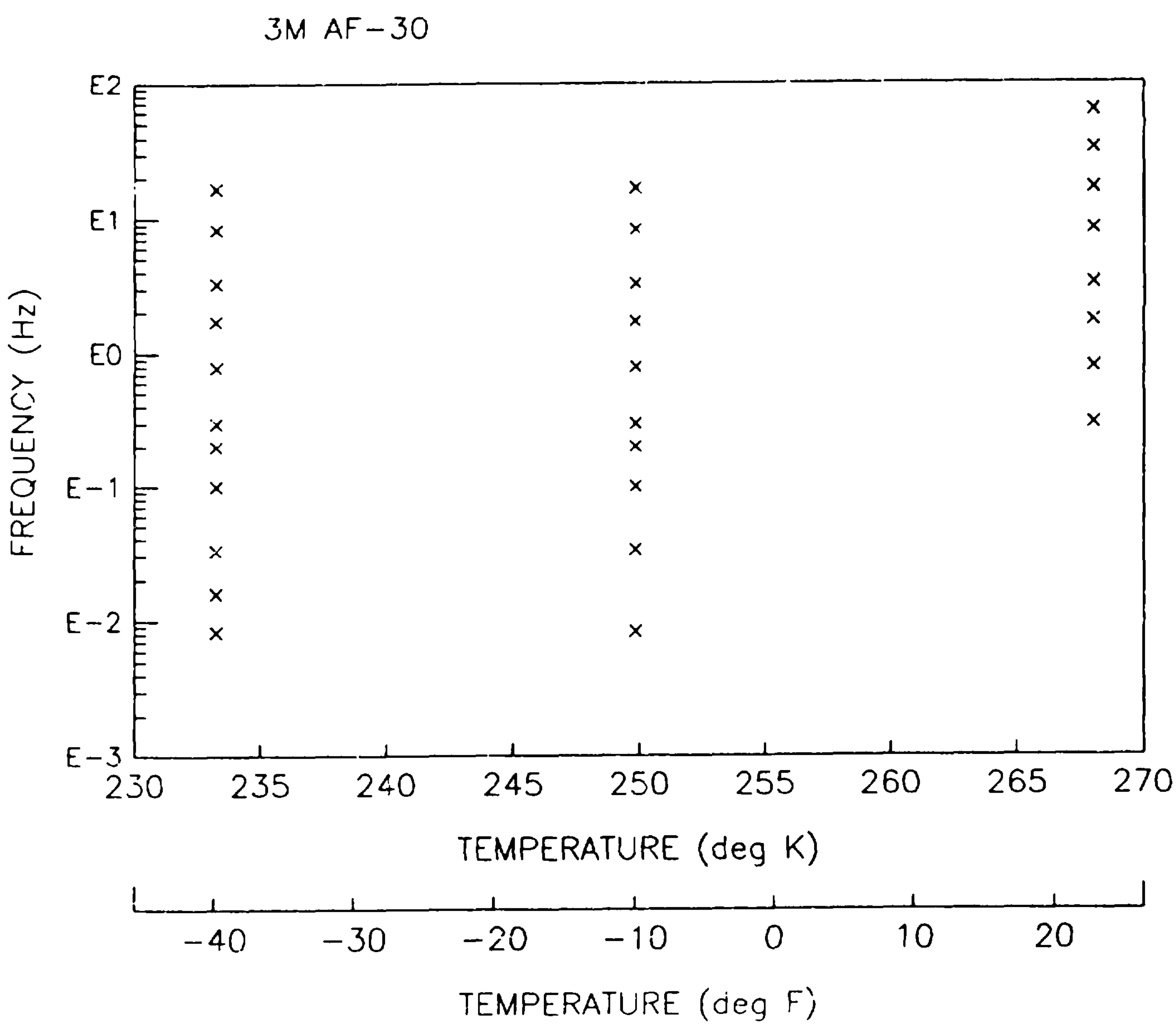
3M AF-30

YOUNG'S

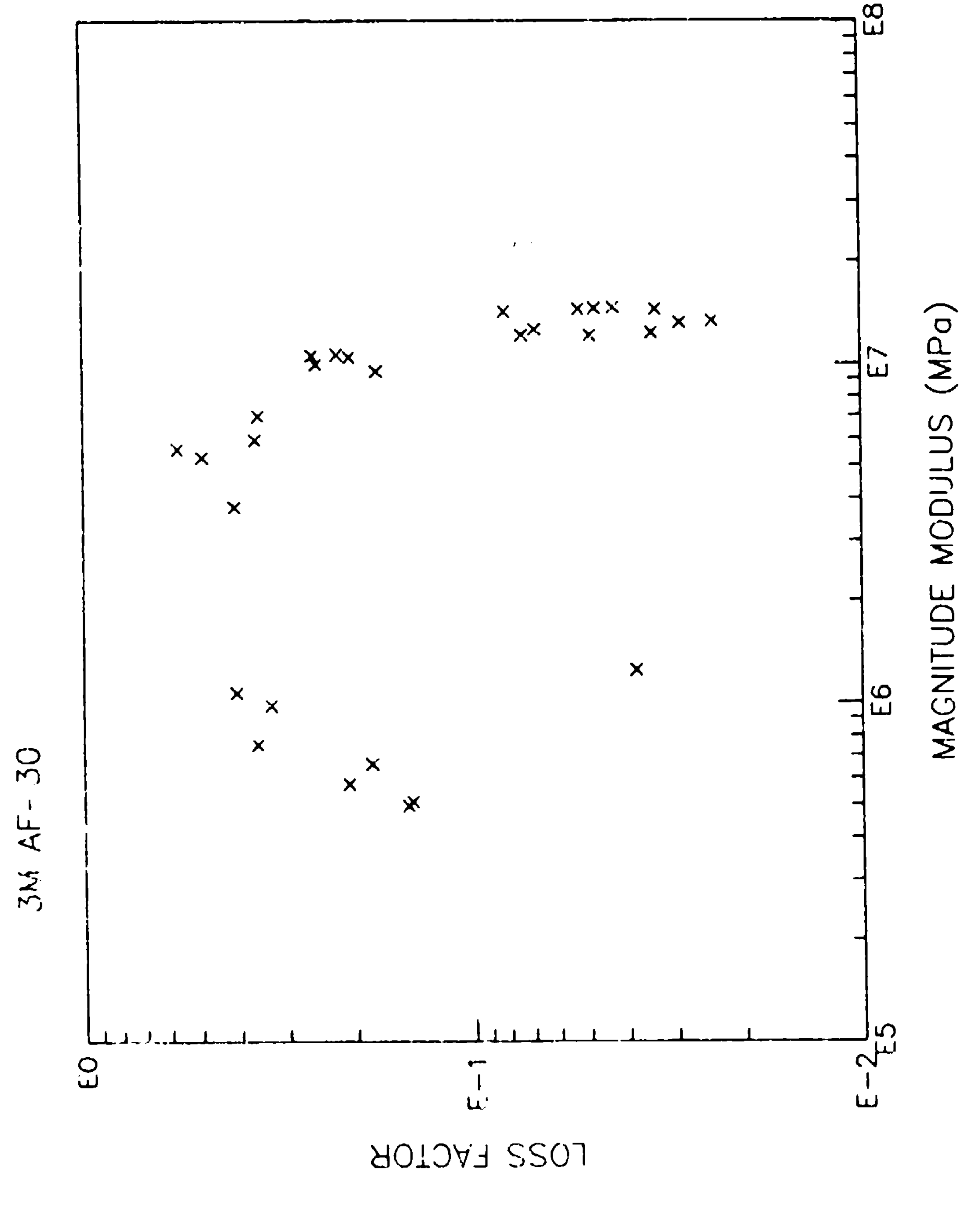


3M AF-30 YOUNG'S



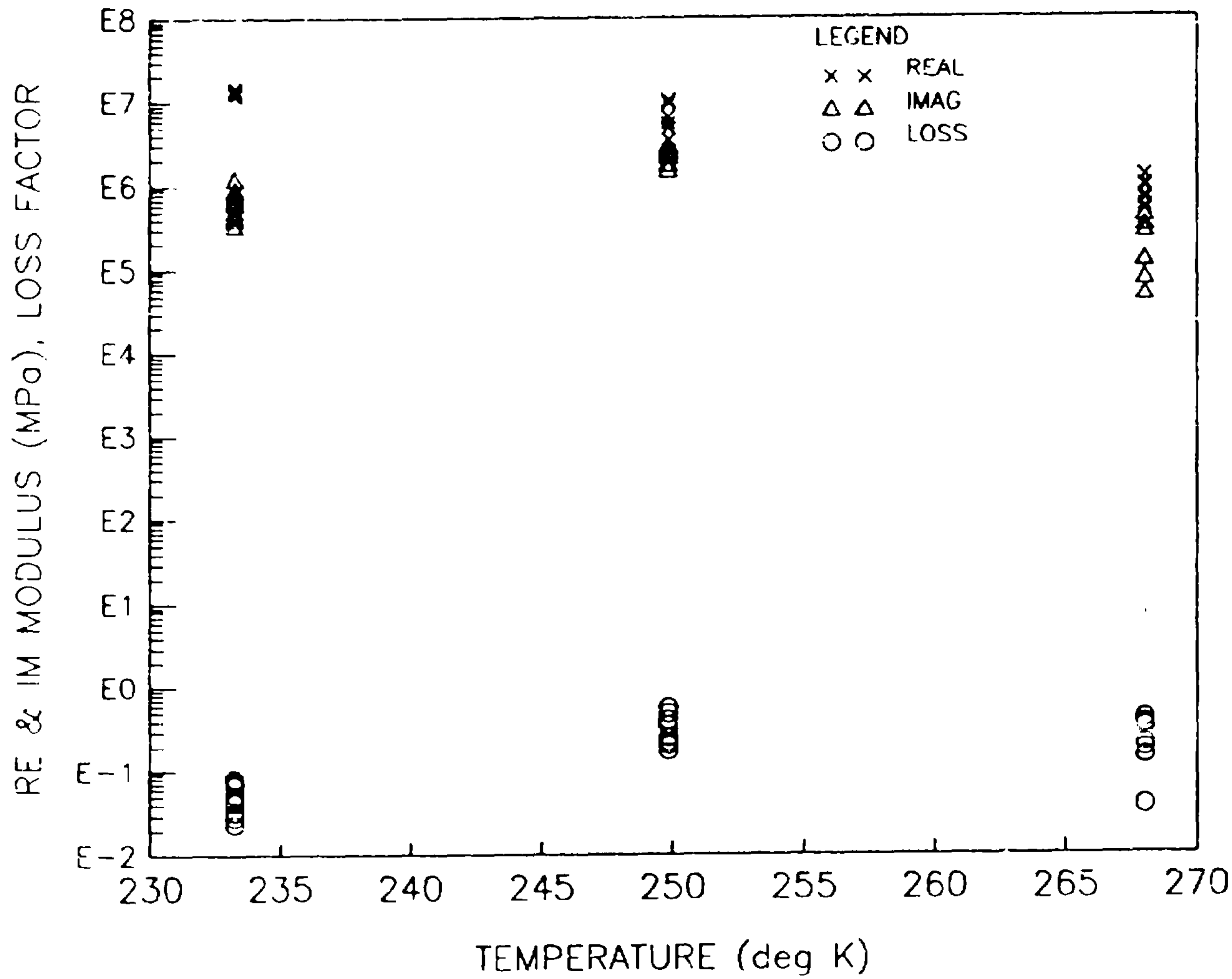


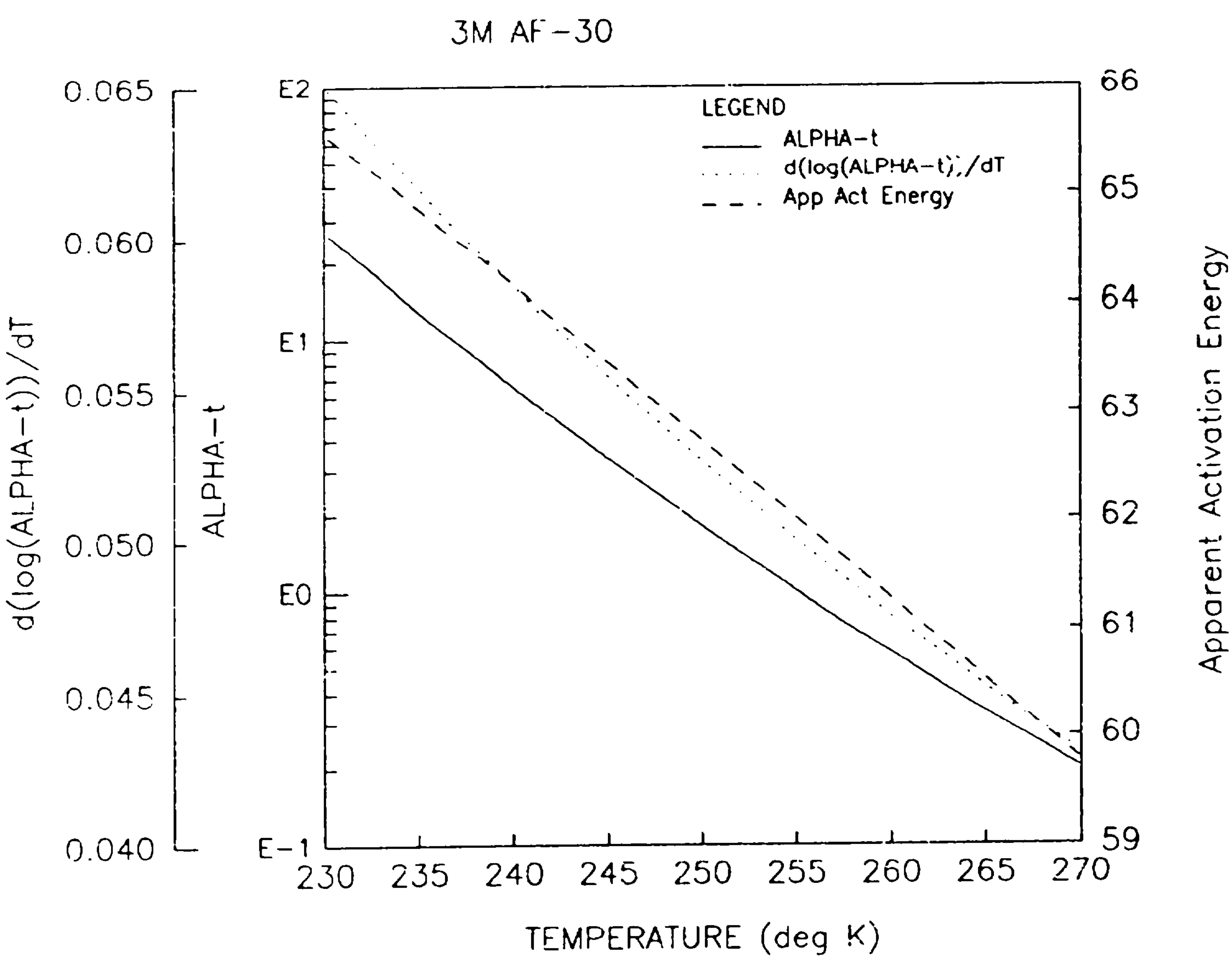
3M AF-30
E2
E1
E0
E-1
E-2
E-3
FREQUENCY (Hz)
230
235
240
245
250
255
260
265
270
TEMPERATURE (deg K)
-40
-30
-20
-10
0
10
20
TEMPERATURE (deg F)



3M AF-30
LOSS FACTOR
E0
E-1
E-2
E5
E6
E7
E8
MAGNITUDE MODULUS (MPa)

3M AF-30


LEGEND
× × REAL
Δ Δ IMAG
○ ○ LOSS
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
RE & IM MODULUS (MPa), LOSS FACTOR
230
235
240
245
250
255
260
265
270
TEMPERATURE (deg K)


3M AF-30
LEGEND
ALPHA-t
d(log(ALPHA-t)),/dT
App Act Energy
0.065
0.060
0.055
0.050
0.045
0.040
d(log(ALPHA-t))/dT
ALPHA-t
E2
E1
E0
E-1
66
65
64
63
62
61
60
59
Apparent Activation Energy
230
235
240
245
250
255
260
265
270
TEMPERATURE (deg K)

3M AF-30 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	255.0	230.0	270.0	0.5000E-01	0.6500E-01	0.4300E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.3000E+06	0.1500E+08	0.1000	0.4500	1.000	0.1000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
249.8	0.2000	0.6535E+07	0.3547	0.2318E+07
249.8	0.8000	0.1014E+08	0.2583	0.2619E+07
249.8	1.700	0.1029E+08	0.2221	0.2285E+07
249.8	3.300	0.9294E+07	0.1750	0.1626E+07
249.8	8.300	0.9570E+07	0.2517	0.2409E+07
268.0	0.3000	0.4873E+06	0.1480	0.7212E+05
268.0	0.8000	0.5015E+06	0.1440	0.7222E+05
268.0	1.700	0.5586E+06	0.2084	0.1164E+06
268.0	8.300	0.7026E+06	0.3593	0.2524E+06
268.0	16.70	0.9219E+06	0.3301	0.3043E+06
268.0	33.30	0.9812E+06	0.4074	0.3997E+06
268.0	61.70	0.1236E+07	0.3800E-01	0.4697E+05
249.8	0.3000	0.5540E+07	0.3619	0.2005E+07
249.8	16.70	0.1014E+08	0.2054	0.2083E+07
233.2	0.8300E-02	0.1198E+08	0.4900E-01	0.5870E+06
233.2	0.1600E-01	0.1198E+08	0.7350E-01	0.8805E+06
233.2	0.3300E-01	0.1247E+08	0.6810E-01	0.8492E+06
233.2	0.1000	0.1222E+08	0.3420E-01	0.4179E+06
233.2	0.2000	0.1324E+08	0.2410E-01	0.3191E+06
233.2	0.3000	0.1309E+08	0.2900E-01	0.3796E+06
233.2	0.8000	0.1432E+08	0.3340E-01	0.4783E+06
233.2	1.700	0.1405E+08	0.8140E-01	0.1144E+07
233.2	8.300	0.1438E+08	0.4770E-01	0.6859E+06
233.2	16.70	0.1432E+08	0.5250E-01	0.7518E+06
249.8	0.8300E-02	0.3451E+07	0.4092	0.1412E+07
249.8	0.3330E-01	0.4814E+07	0.5698	0.2743E+07
233.2	3.300	0.1449E+08	0.4290E-01	0.6216E+06
249.8	0.1000	0.4713E+07	0.4901	0.2310E+07
268.0	3.300	0.6447E+06	0.1822	0.1175E+06

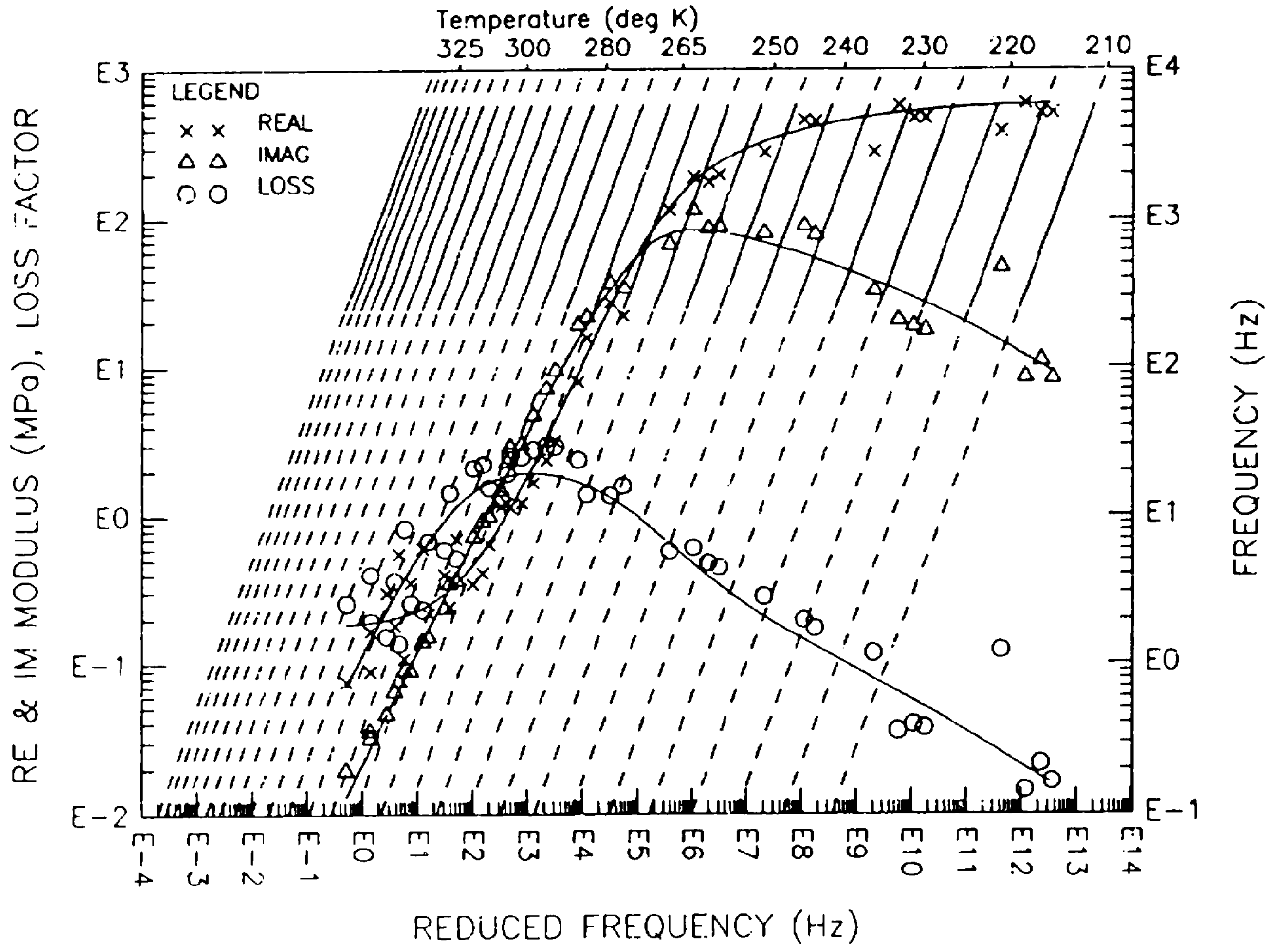
SOUNDCOAT R

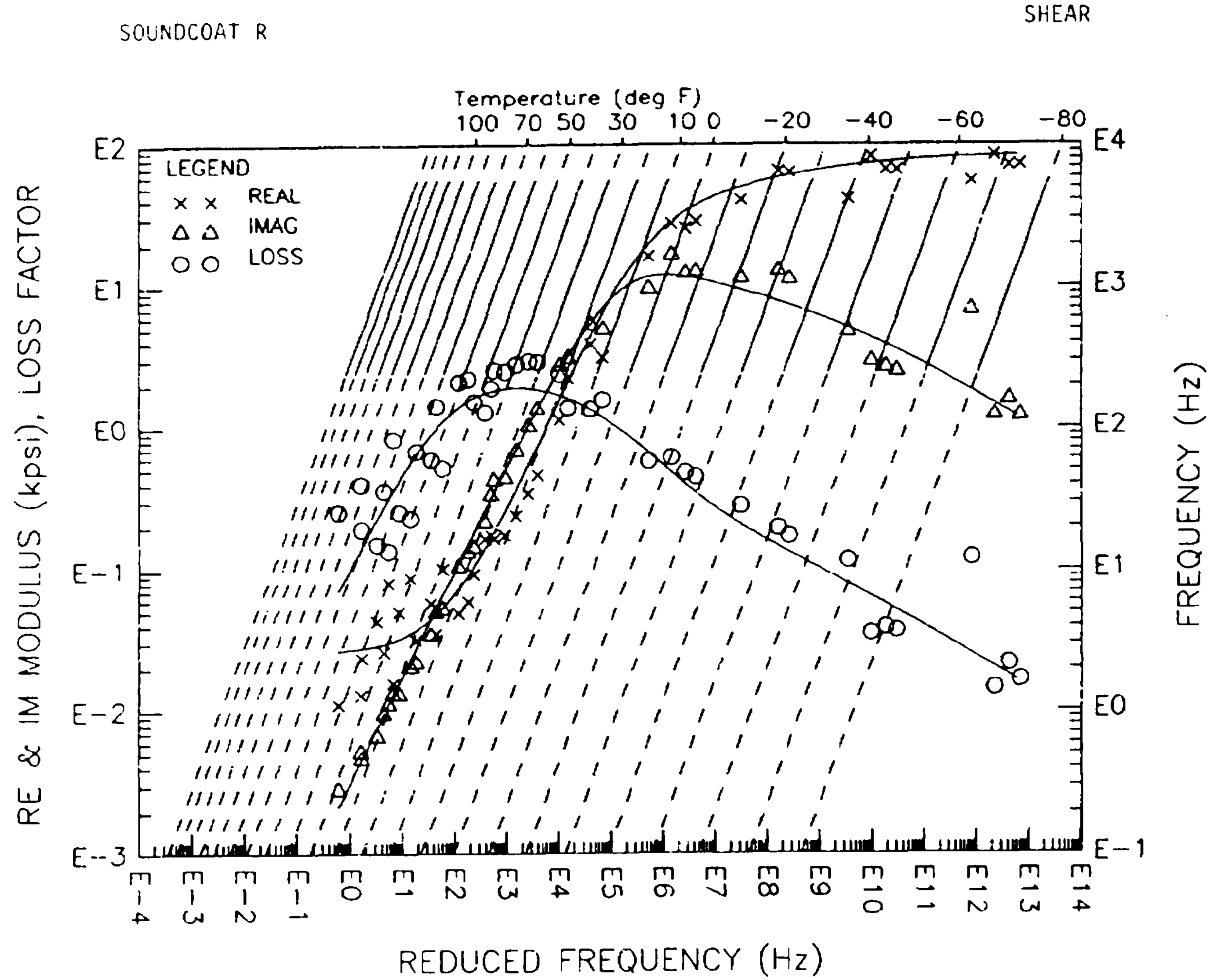
SHEAR

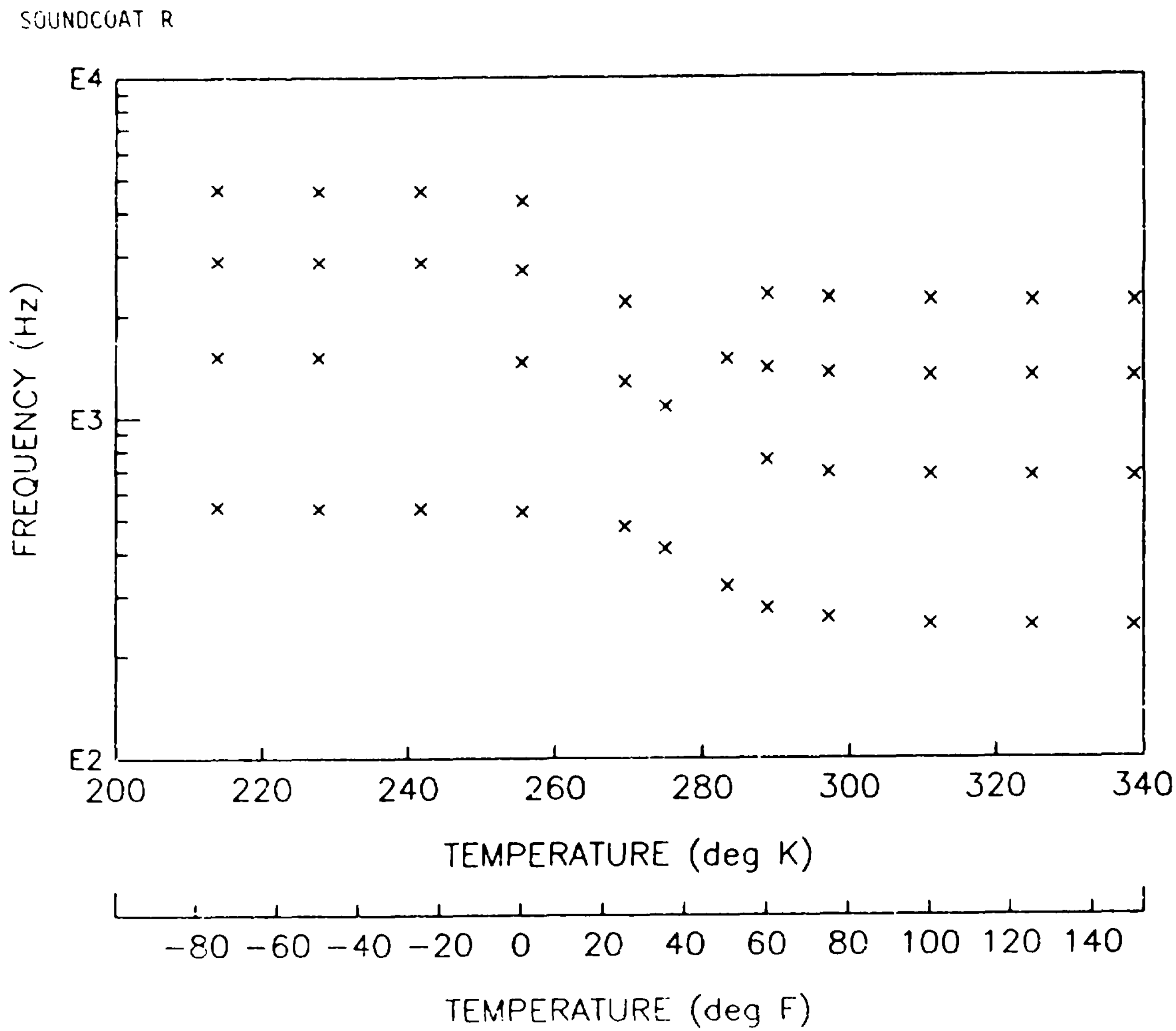
		GLASSY (IE, MAX EXPERI!. NTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1586E-01	1.352	1.931	1.352	0.7039E-01
MODULUS	MPA	581.3	25.36	1.943	0.4425	0.1839
	PSI	0.8431E+05	3678.	281.7	64.18	26.67
10.HZ	DEG K		250.0	263.0	274.0	
	DEG C		-43.15	-30.15	-19.15	
	DEG F		-45.67	-22.27	-2.470	
100.HZ	DEG K		259.0	273.0	286.0	
	DEG C		-34.15	-20.15	-7.150	
	DEG F		-29.47	-4.270	19.13	
1000.HZ	DEG K		268.0	284.0	301.0	
	DEG C		-25.15	-9.150	7.850	
	DEG F		-13.27	15.53	46.13	

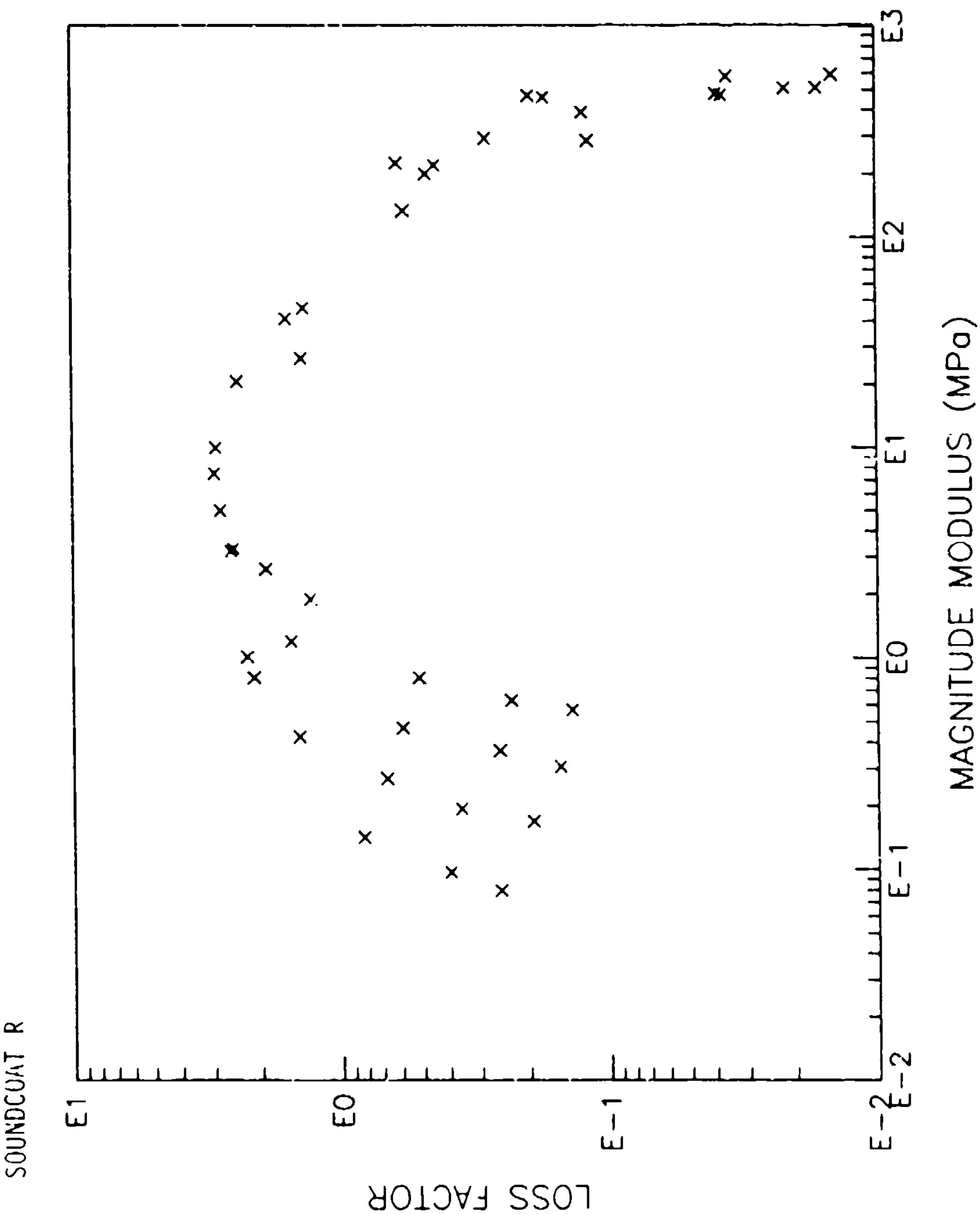
SOUNDCOAT R

SHEAR

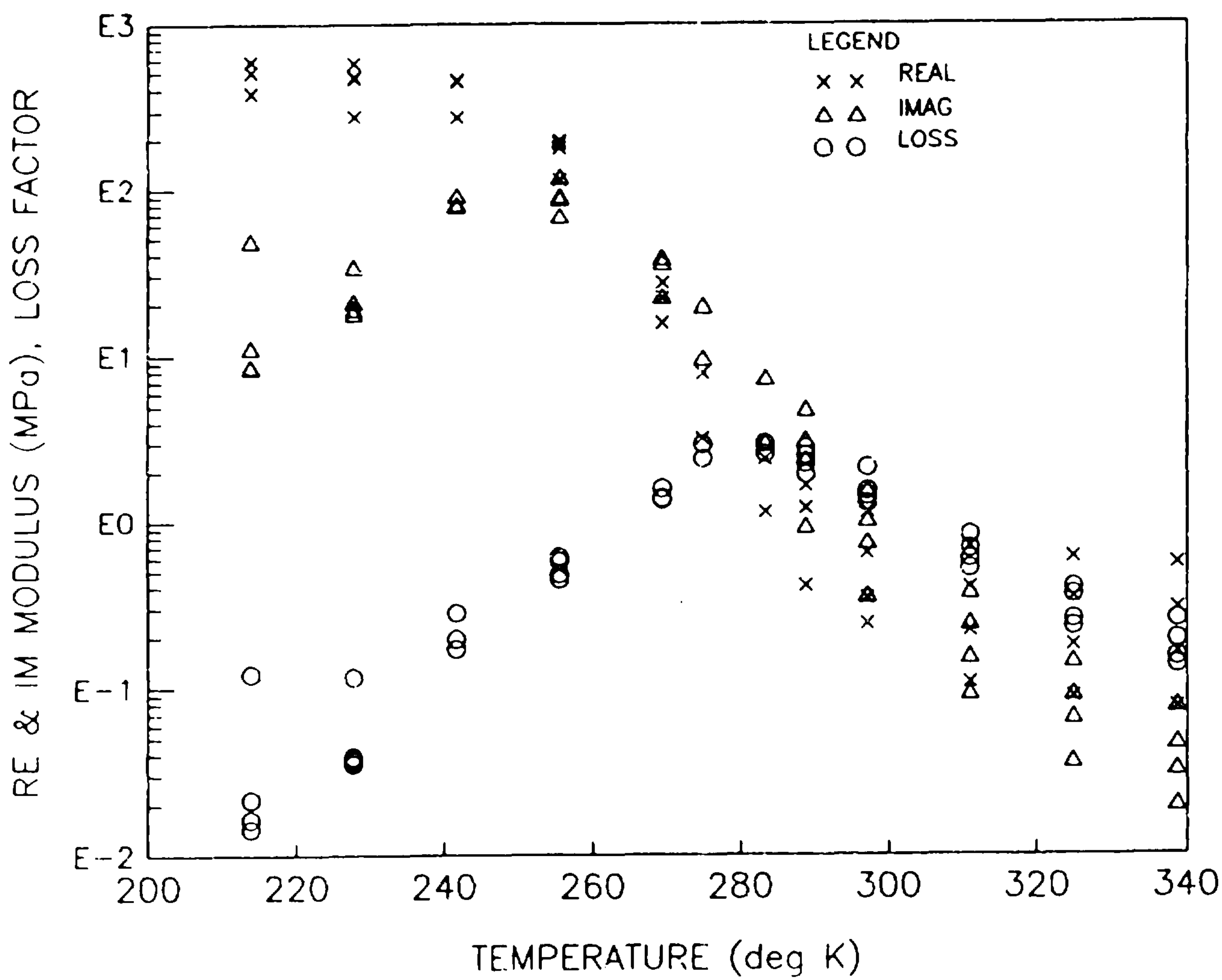



SOUNDCOAT R
SHEAR
Temperature (deg F)
100 70 50 30 10 0 -20 -40 -60 -80
LEGEND
× × REAL
Δ Δ IMAG
○ ○ LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E2 E1 E0 E-1 E-2 E-3
FREQUENCY (Hz)
E4 E3 E2 E1 E0 E-1
E-4 E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14
REDUCED FREQUENCY (Hz)

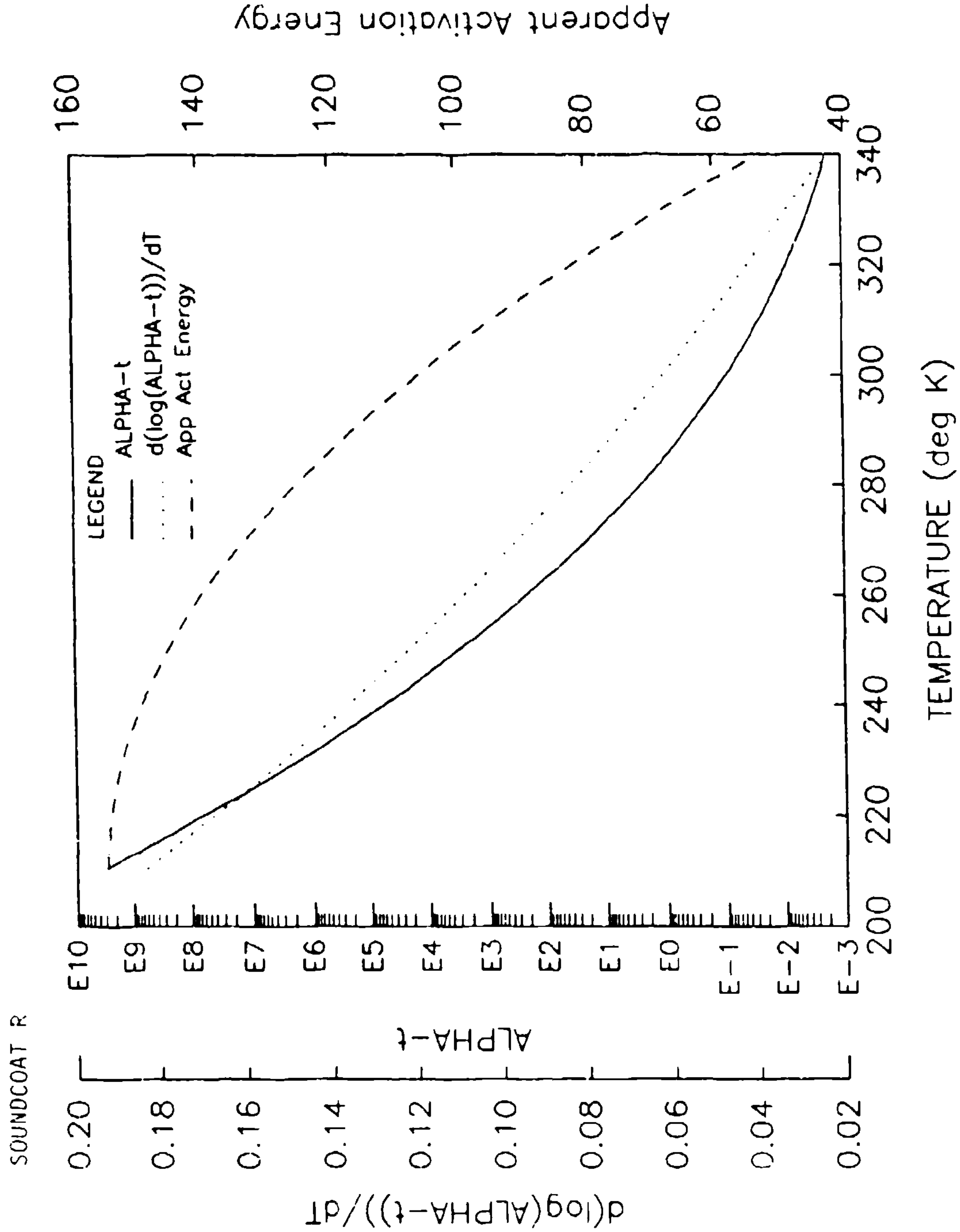

SOUNDCOAT R
E4
E3
E2
FREQUENCY (Hz)
200
220
240
260
280
300
320
340
TEMPERATURE (deg K)
-80 -60 -40 -20 0 20 40 60 80 100 120 140
TEMPERATURE (deg F)


SOUNDCOAT R
LOSS FACTOR
E1
E0
E−1
E−2
E−2
E−1
E0
E1
E2
E3
MAGNITUDE MODULUS (MPa)

SOUNDCOAT R



LEGEND
REAL
IMAG
LOSS
E3
E2
E1
E0
E-1
E-2
RE & IM MODULUS (MPa), LOSS FACTOR
200
220
240
260
280
300
320
340
TEMPERATURE (deg K)


SOUNDCOAT R
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
ALPHA-t
d(log(ALPHA-t))/dT
Apparent Activation Energy
200
220
240
260
280
300
320
340
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
160
140
120
100
80
60
40

SOUNDCOAT R   SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	285.0	210.0	340.0	0.7796E-01	0.1840	0.2384E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.1785	605.9	0.7310E+06	0.7500	1.732	0.2367

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

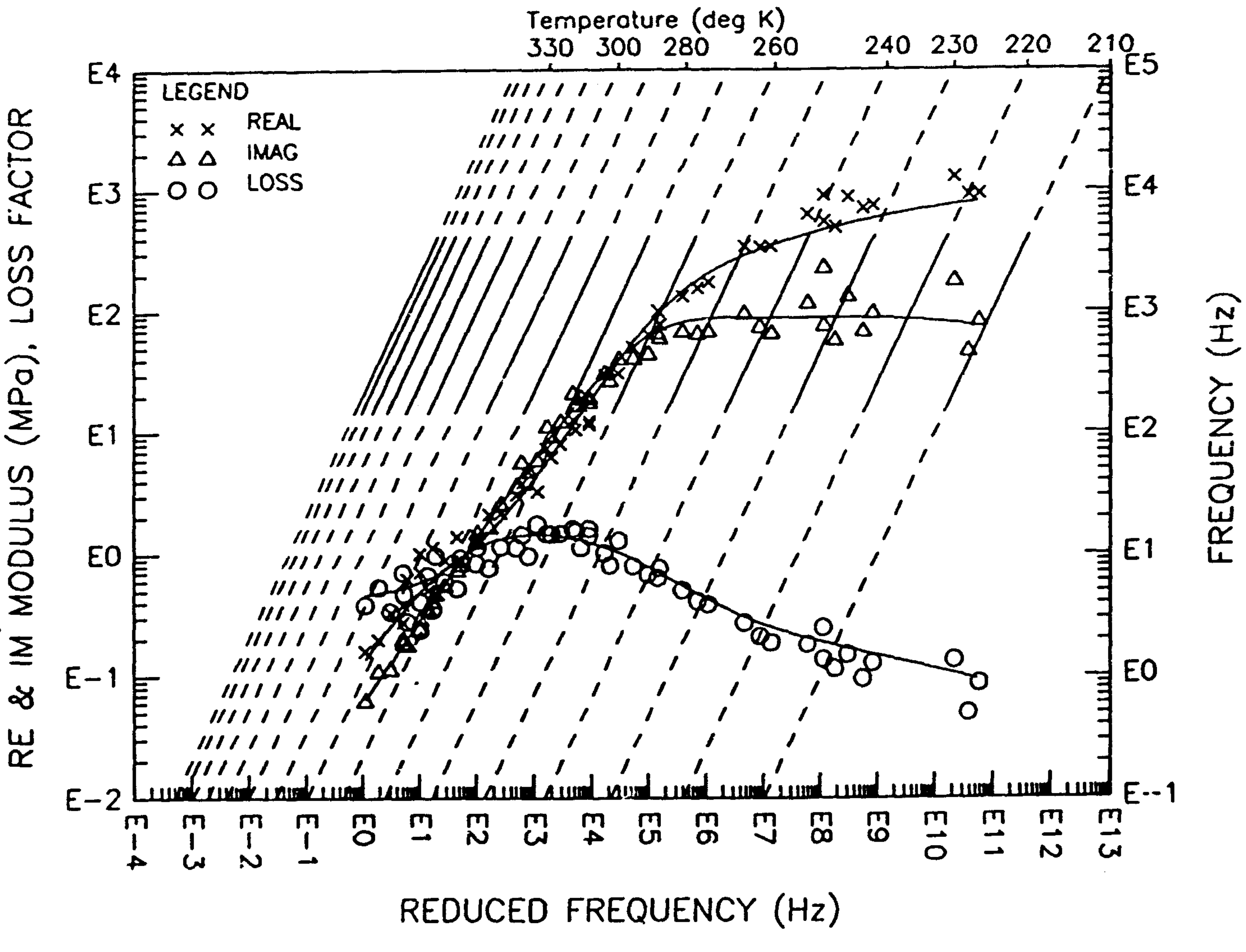
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
213.7	545.3	384.1	0.1221	46.90
213.7	1506.	585.2	0.1438E-01	8.415
213.7	2877.	502.6	0.2167E-01	10.89
213.7	4653.	506.0	0.1640E-01	8.298
227.6	541.1	281.3	0.1167	32.83
227.6	1500.	571.6	0.3543E-01	20.25
227.6	2860.	470.8	0.3906E-01	18.39
227.6	4617.	465.9	0.3719E-01	17.33
241.5	539.7	278.6	0.2821	78.59
241.5	2850.	453.1	0.1963	88.94
241.5	4596.	446.2	0.1719	76.70
255.4	528.7	114.3	0.5756	65.79
255.4	1450.	188.7	0.6086	114.8
255.4	2703.	177.3	0.4792	84.96
255.4	4312.	197.1	0.4450	87.71
269.3	478.0	15.47	1.384	21.41
269.3	1273.	27.08	1.357	36.75
269.3	2176.	21.74	1.581	34.37
274.8	411.8	3.192	2.927	9.343
274.8	1085.	7.860	2.397	18.84
283.2	320.7	1.143	2.566	2.933
283.2	1476.	2.386	2.964	7.072
288.7	275.4	0.4086	2.229	0.9108
288.7	751.4	1.206	1.912	2.306
288.7	1390.	1.211	2.504	3.032
288.7	2278.	1.658	2.813	4.664
297.0	258.4	0.2413	1.427	0.3443
297.0	690.9	0.3421	2.112	0.7225
297.0	1345.	0.6450	1.535	0.9901
297.0	2227.	1.149	1.289	1.481
310.9	246.9	0.1083	0.8293	0.8981E-01
310.9	678.4	0.2200	0.6802	0.1496
310.9	1324.	0.3975	0.5934	0.2359
310.9	2193.	0.7047	0.5168	0.3642
324.8	244.6	0.8895E-01	0.3986	0.3546E-01
324.8	673.6	0.1799	0.3611	0.6496E-01
324.8	1317.	0.3492	0.2559	0.8936E-01
324.8	2180.	0.6063	0.2319	0.1406
338.7	242.7	0.7626E-01	0.2553	0.1947E-01
338.7	670.2	0.1642	0.1936	0.3179E-01

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
338.7	1310.	0.2993	0.1524	0.4561E-01
338.7	2170.	0.5561	0.1366	0.7596E-01

ISD 112 SHEAR

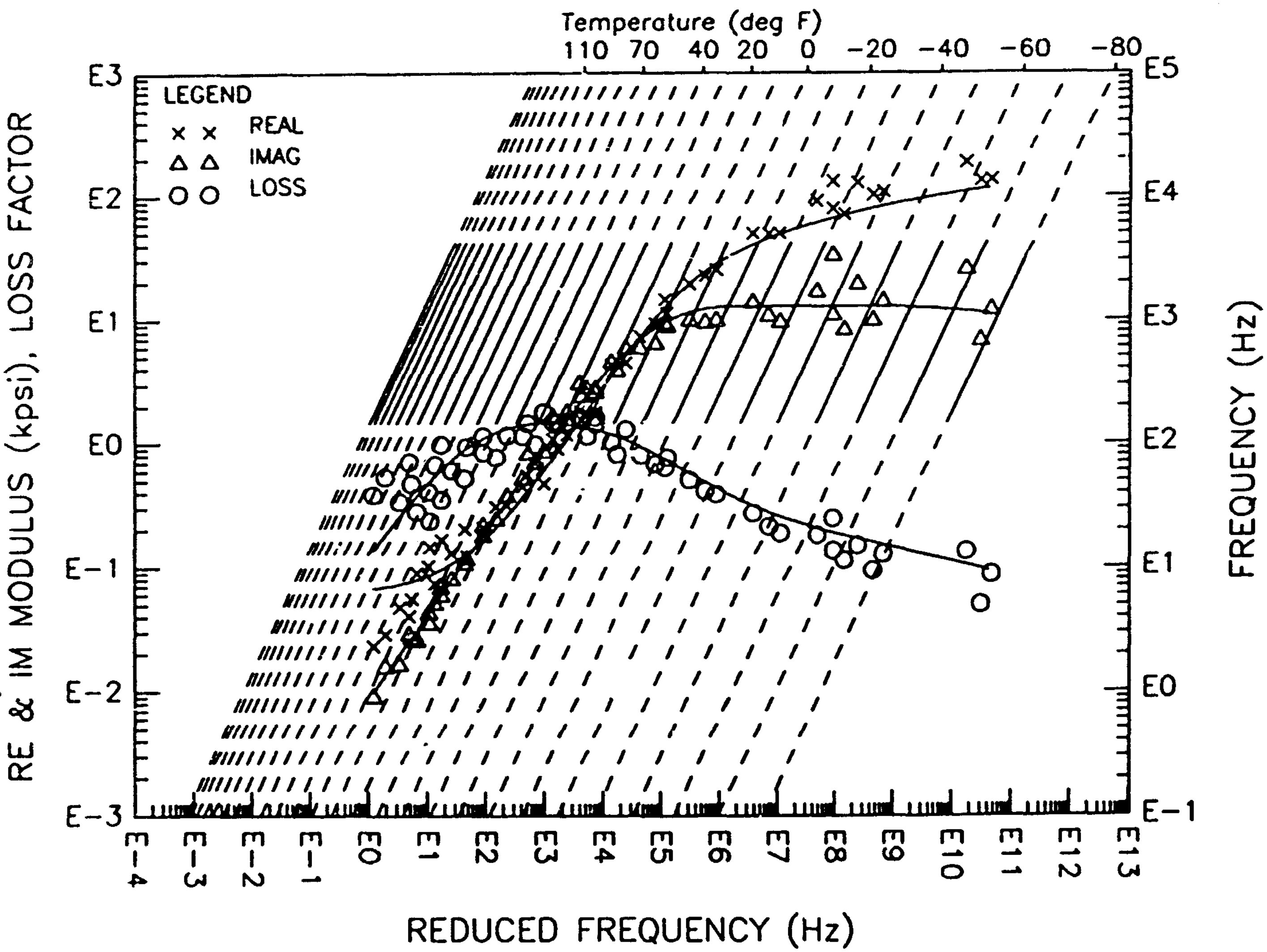
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.9328E-01	1.019	1.455	1.019	0.1378
MODULUS	MPA	809.5	43.55	4.483	1.048	0.4655
	PSI	0.1174E+06	6315.	650.2	152.0	67.51
10.HZ	DEG K		246.0	262.0	277.0	
	DEG C		-47.15	-31.15	-16.15	
	DEG F		-52.87	-24.07	2.930	
100.HZ	DEG K		256.0	275.0	293.0	
	DEG C		-37.15	-18.15	-.1500	
	DEG F		-34.87	-.6700	31.73	
1000.HZ	DEG K		268.0	290.0	314.0	
	DEG C		-25.15	-3.150	20.85	
	DEG F		-13.27	26.33	69.53	

ISD 112 SHEAR

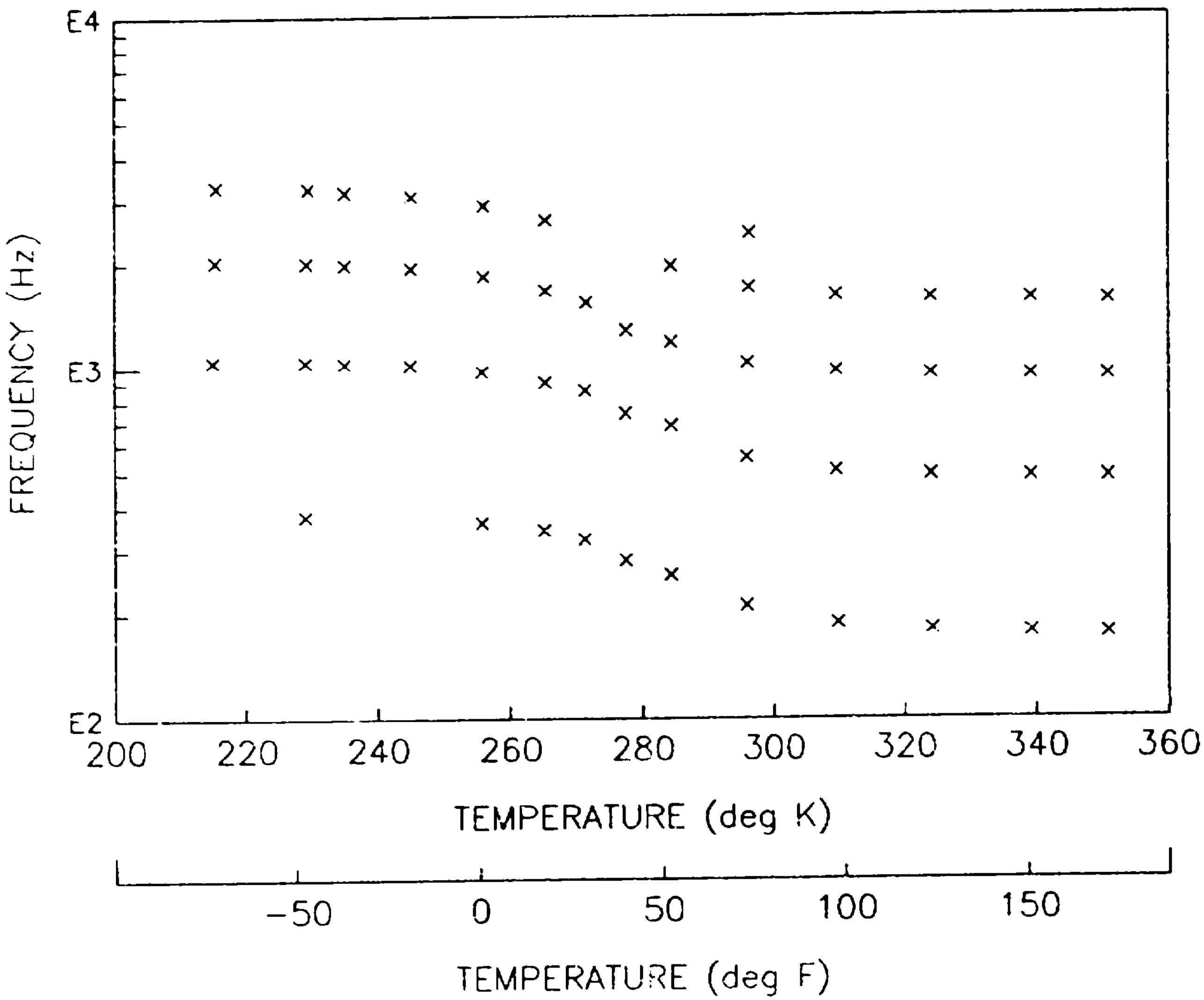


ISD 112

SHEAR

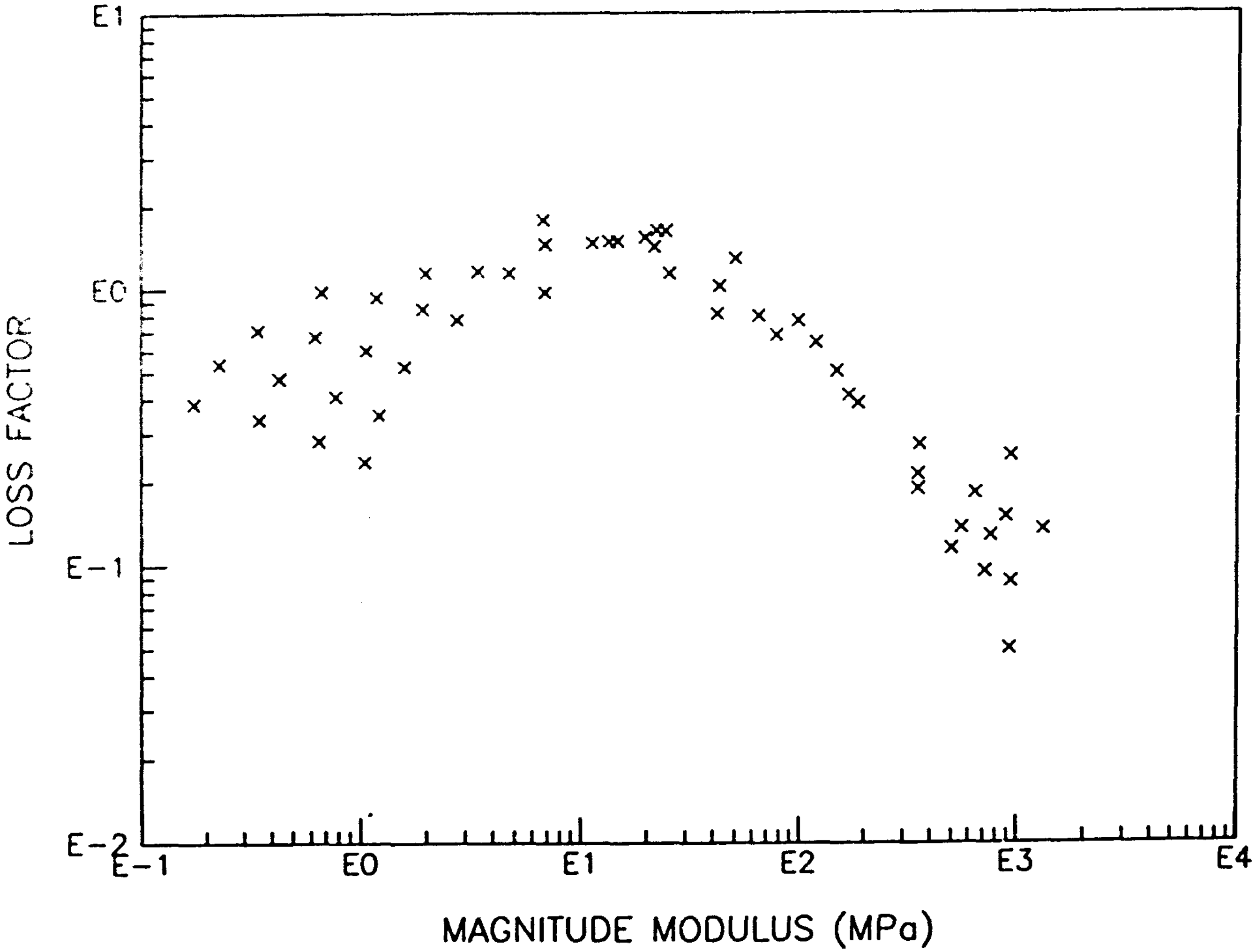


ISD 112

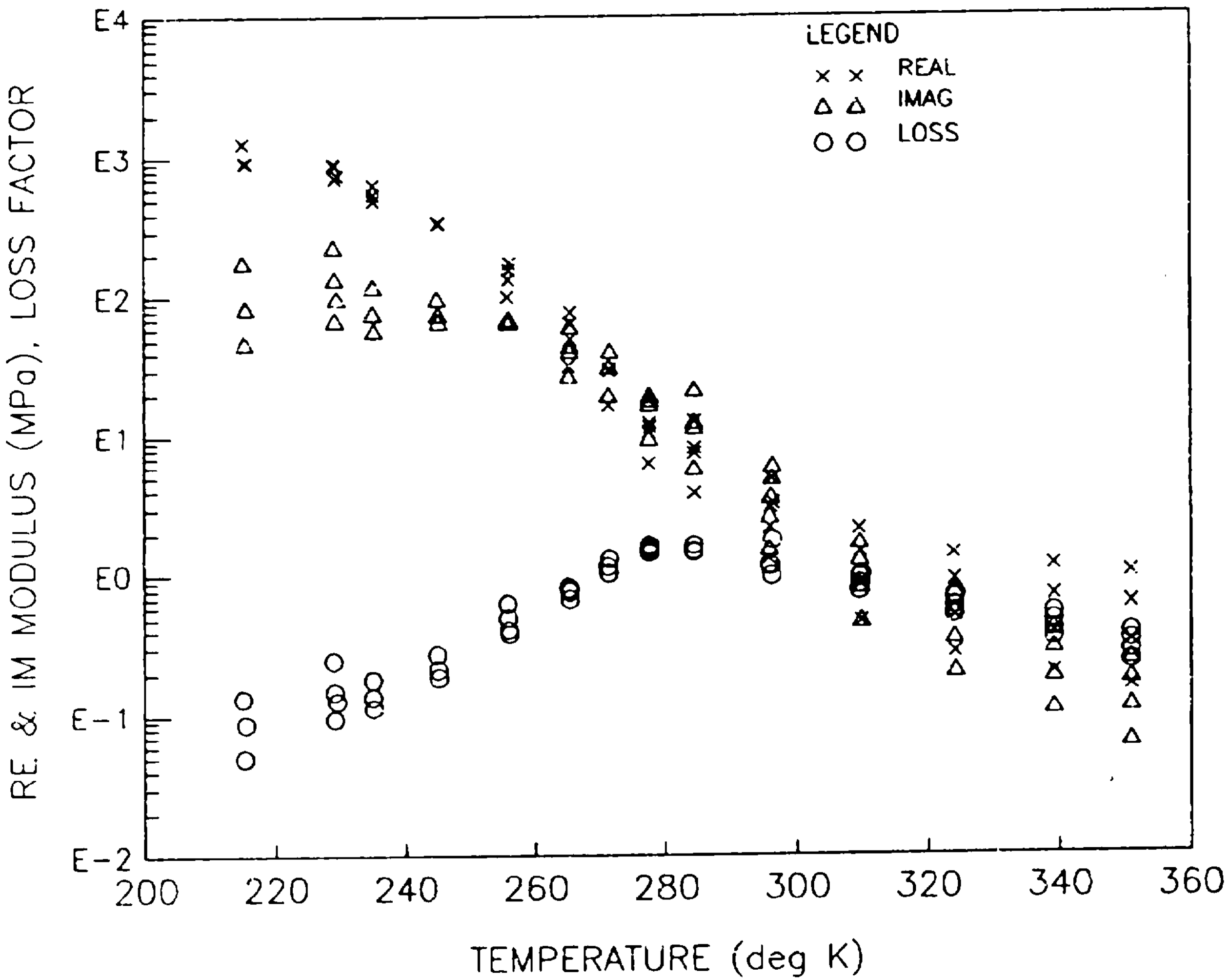


E4
E3
E2
FREQUENCY (Hz)
200
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)
-50
0
50
100
150
TEMPERATURE (deg F)

ISD 112

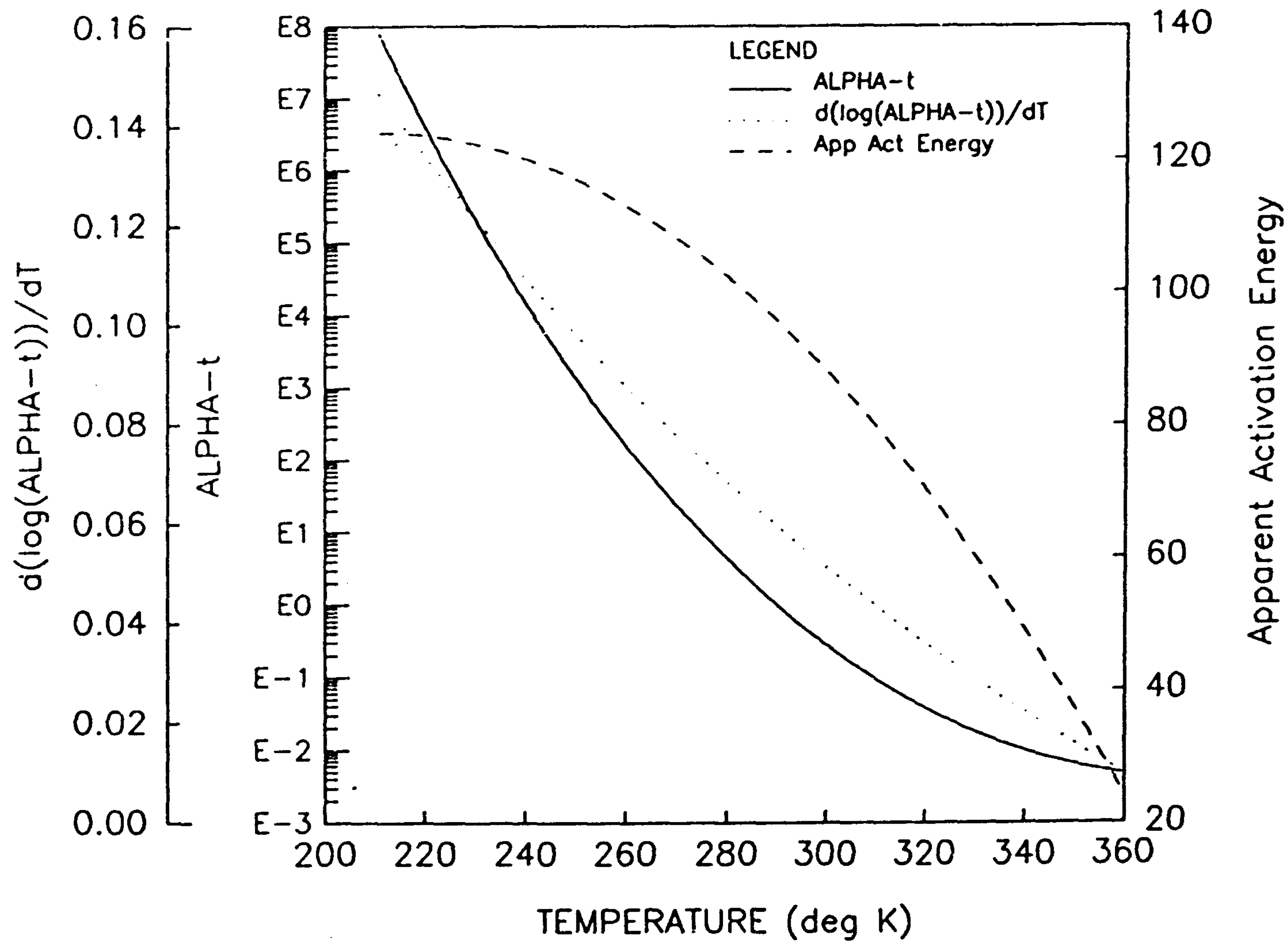


ISD 112



LEGEND
REAL
IMAG
LOSS
E4
E3
E2
E1
E0
E-1
E-2
200
220
240
260
280
300
320
340
360
RE & IM MODULUS (MPa), LOSS FACTOR
TEMPERATURE (deg K)

ISD 112



0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
d(log(ALPHA-t))/dT
ALPHA-t
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
140
120
100
80
60
40
20
Apparent Activation Energy
200
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)

ISD 112 SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	290.0	210.0	360.0	0.5956E-01	0.1474	0.9725E-02

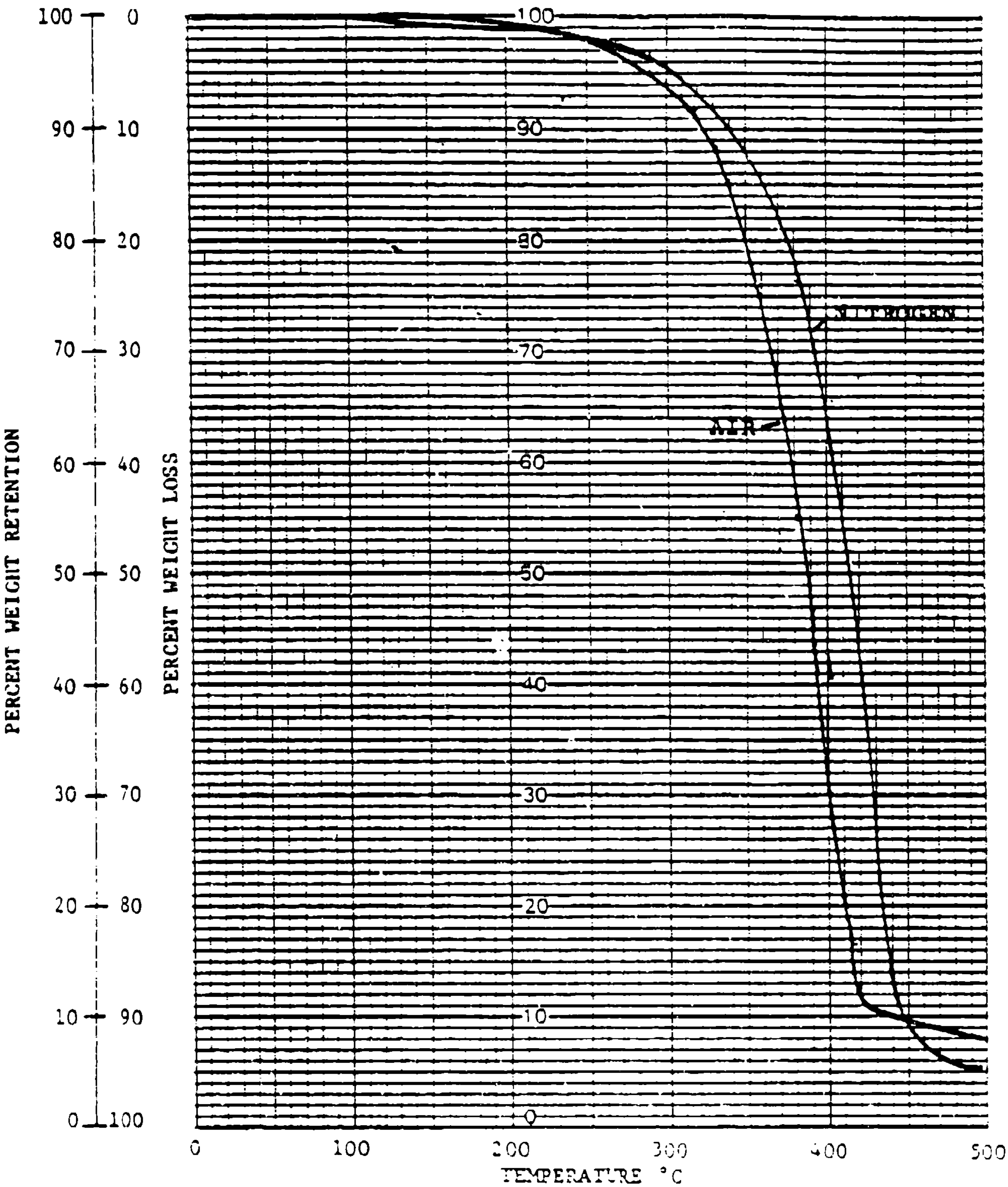
COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.4307	1200.	0.1543E+07	0.6847	3.241	0.1800

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
295.7	210.5	1.289	1.149	1.481
295.8	548.7	2.203	1.160	2.555
295.9	1031.	3.080	1.139	3.508
296.1	1693.	4.860	0.9746	4.737
296.2	2418.	3.271	1.777	5.813
284.2	256.1	3.854	1.451	5.592
284.2	682.2	7.453	1.485	11.07
284.2	1188.	8.136	1.490	12.12
284.2	1954.	12.74	1.625	20.70
271.1	322.0	16.76	1.140	19.11
271.2	853.9	29.83	1.025	30.58
271.3	1535.	30.75	1.292	39.73
255.6	360.4	100.7	0.6388	64.33
255.7	974.0	133.6	0.5048	67.44
255.8	1831.	156.6	0.4131	64.69
255.9	2903.	174.3	0.3858	67.24
244.8	1017.	345.0	0.2734	94.32
244.9	1938.	343.3	0.2137	73.36
245.0	3101.	345.5	0.1884	65.09
228.8	377.0	908.1	0.2483	225.5
228.9	1042.	880.5	0.1499	132.0
229.0	2005.	709.5	0.9476E-01	67.23
229.3	3265.	748.1	0.1279	95.68
214.8	1049.	1291.	0.1345	173.6
215.1	2026.	921.9	0.5002E-01	46.11
215.3	3303.	931.5	0.8742E-01	81.43
234.8	1034.	632.8	0.1820	115.2
234.8	1984.	550.2	0.1368	75.27
234.9	3187.	494.5	0.1147	56.72
265.0	341.7	32.30	0.8126	26.25
265.2	903.0	50.24	0.7991	40.15
265.2	1662.	64.32	0.6819	43.86
265.2	2637.	77.84	0.7686	59.83
277.3	281.6	6.279	1.466	9.205
277.3	736.7	10.66	1.541	16.43
277.4	1283.	11.59	1.628	18.87
277.4	1283.	12.37	1.425	17.63
309.7	187.2	0.4742	0.9796	0.4645
309.5	502.7	0.8564	0.9346	0.8004
309.5	975.3	1.451	0.8459	1.227

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
309.4	1604.	2.144	0.7725	1.656
324.0	179.2	0.2777	0.7138	0.1982
323.9	489.5	0.5145	0.6751	0.3473
323.9	954.8	0.9032	0.6007	0.5426
323.8	1576.	1.396	0.5230	0.7301
339.0	175.7	0.1993	0.5378	0.1072
339.0	483.5	0.3860	0.4743	0.1831
339.0	945.8	0.7088	0.4080	0.2892
339.0	1563.	1.144	0.3506	0.4011
350.8	173.7	0.1606	0.3864	0.6206B-01
350.8	480.5	0.3305	0.3393	0.1121
350.8	940.1	0.6238	0.2815	0.1756
350.8	1554.	1.011	0.2374	0.2400


PERCENT WEIGHT RETENTION
PERCENT WEIGHT LOSS
100 0
90 10
80 20
70 30
60 40
50 50
40 60
30 70
20 80
10 90
0 100
NITROGEN
AIR
0
100
200
300
400
500
TEMPERATURE °C

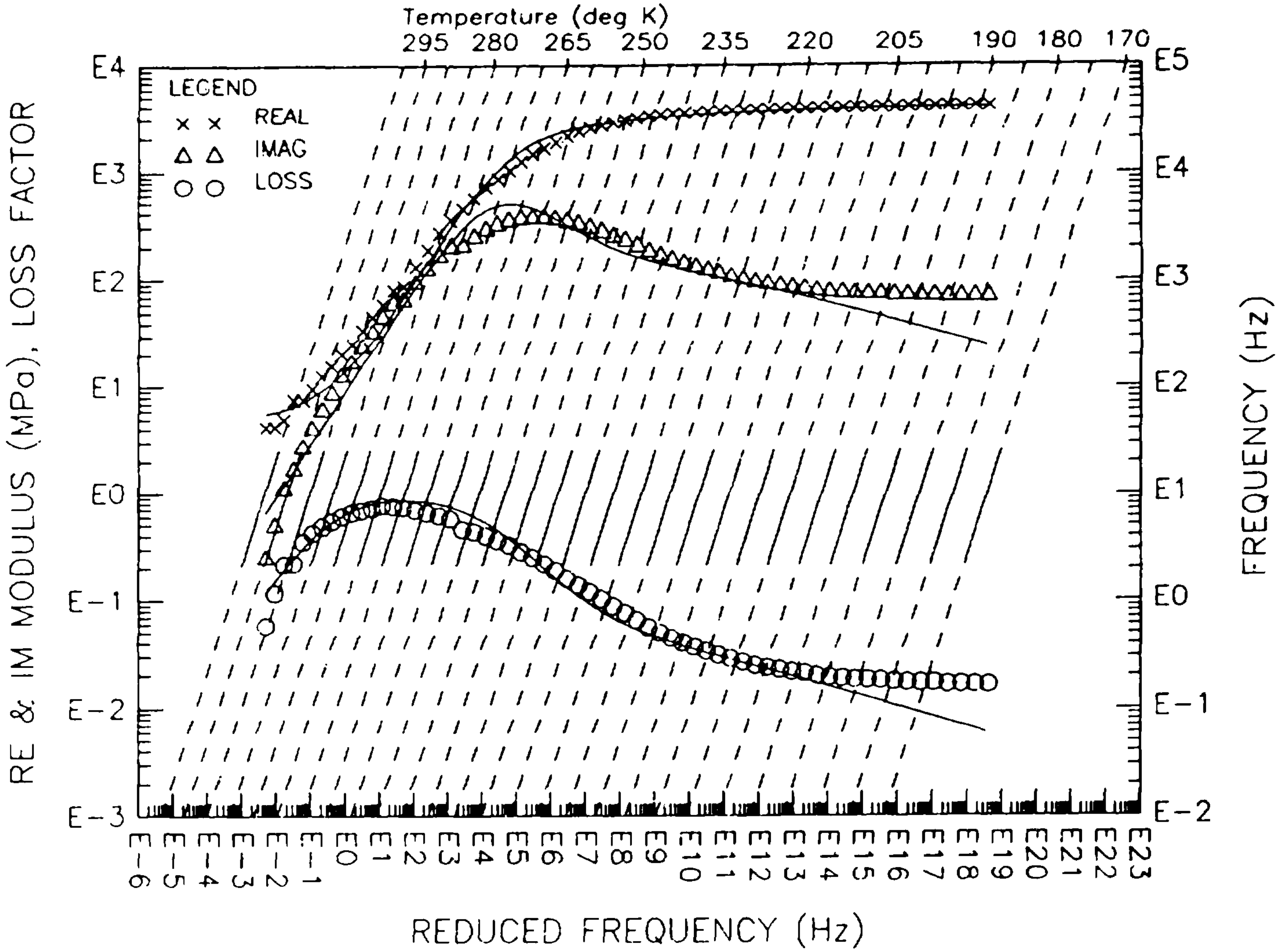
[illegible]

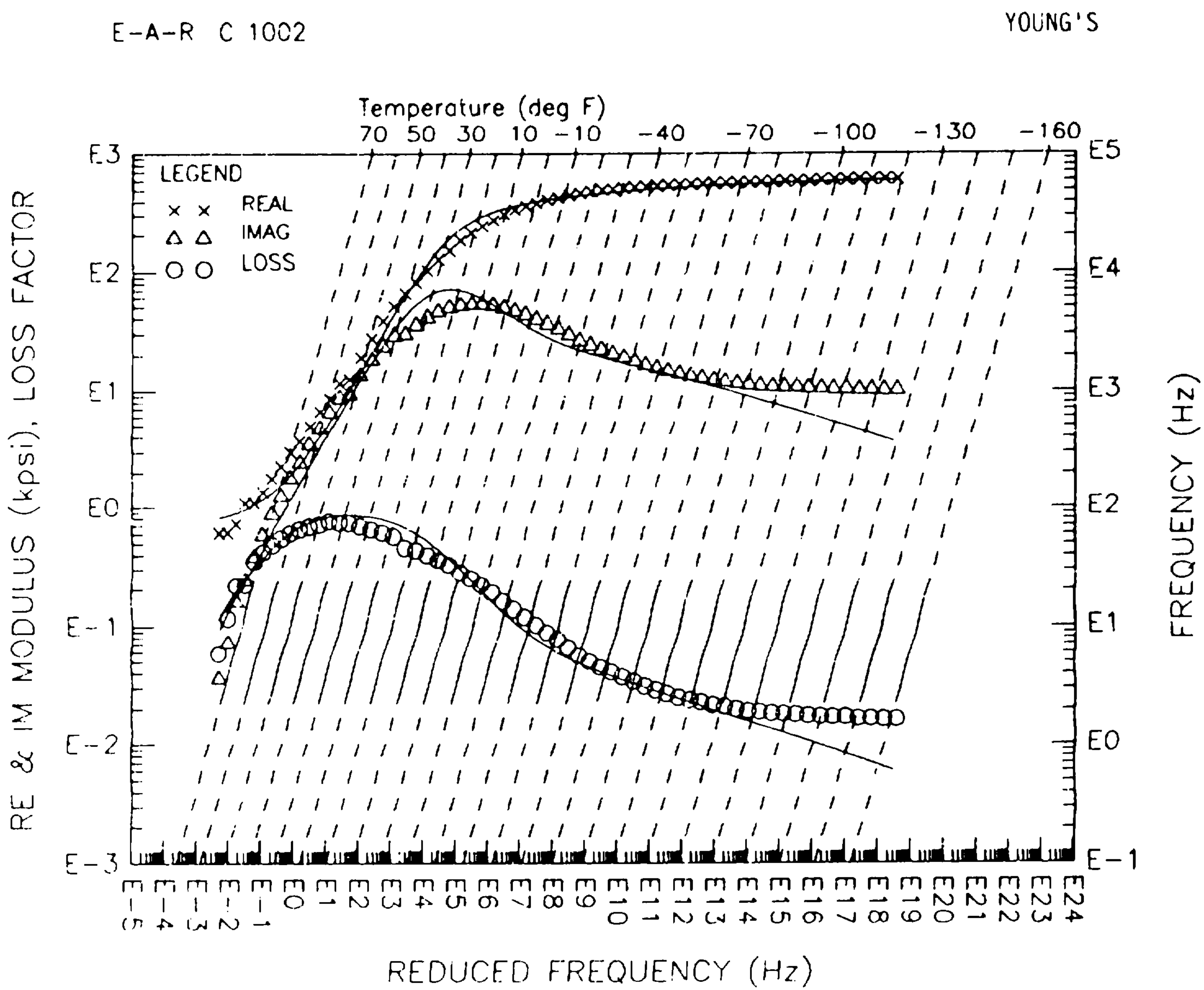
E-A-R C1002

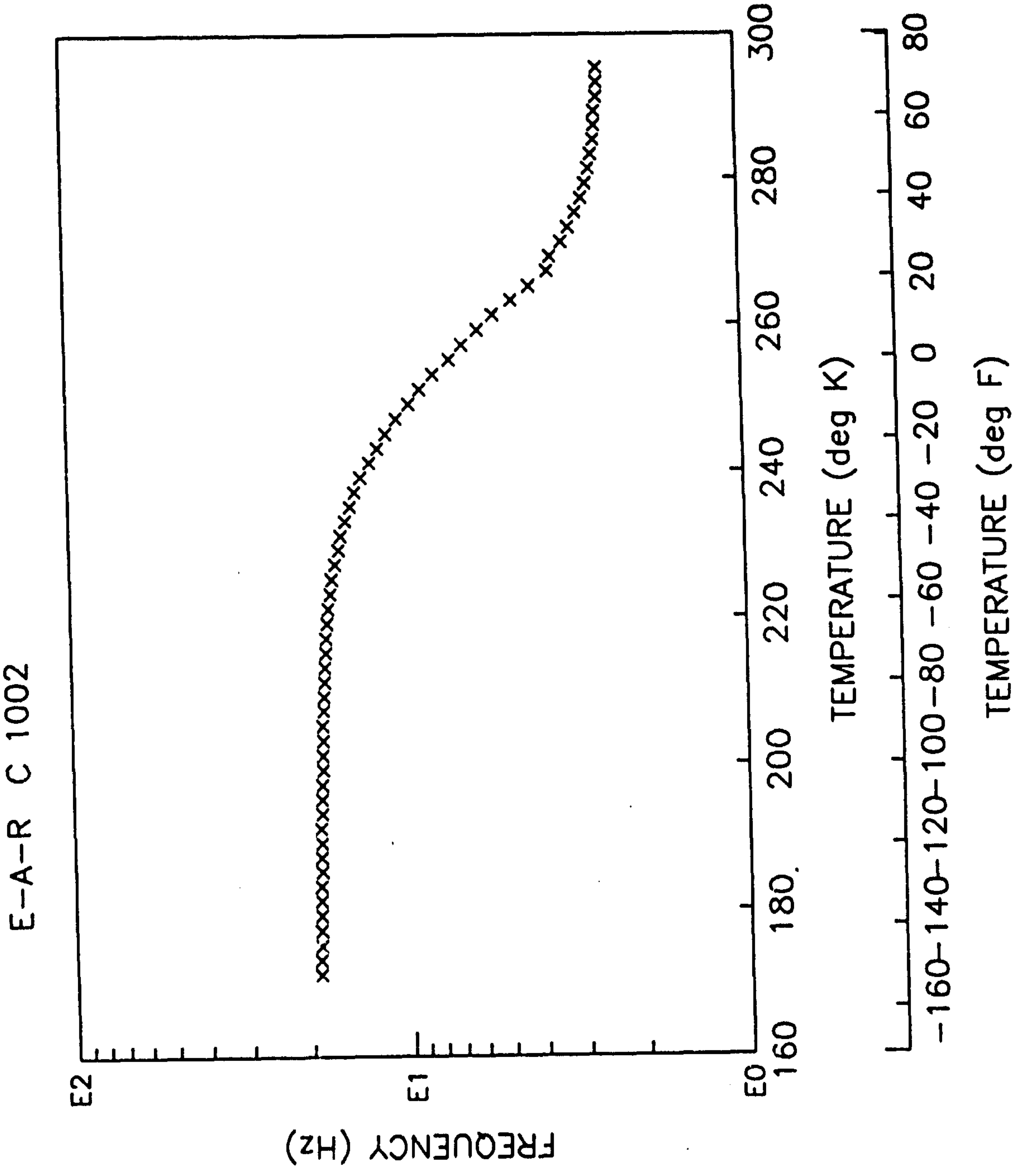
YOUNG'S

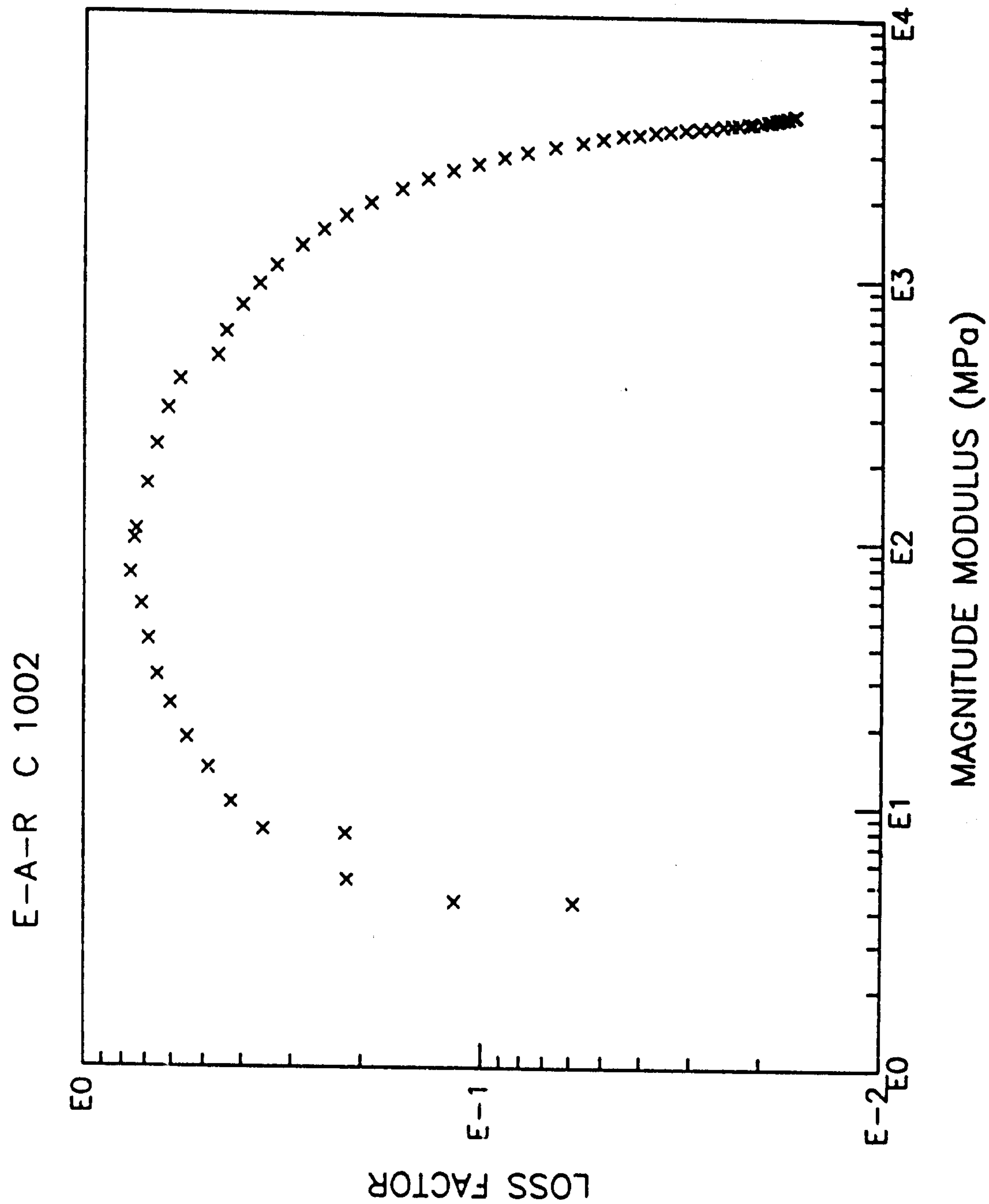
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.5905E-02	0.6023	0.8605	0.6023	0.1151
MODULUS	MPA	4144.	690.9	72.65	13.49	5.651
	PSI	0.6011E+06	0.1002E+06	0.1054E+05	1956.	819.6
10.HZ	DEG K		255.0	270.0	283.0	
	DEG C		-38.15	-23.15	-10.15	
	DEG F		-36.67	-9.670	13.73	
100.HZ	DEG K		262.0	277.0	290.0	
	DEG C		-31.15	-16.15	-3.150	
	DEG F		-24.07	2.930	26.33	
1000.HZ	DEG K		269.0	284.0	298.0	
	DEG C		-24.15	-9.150	4.850	
	DEG F		-11.47	15.53	40.73	

E-A-R C 1002 YOUNG'S

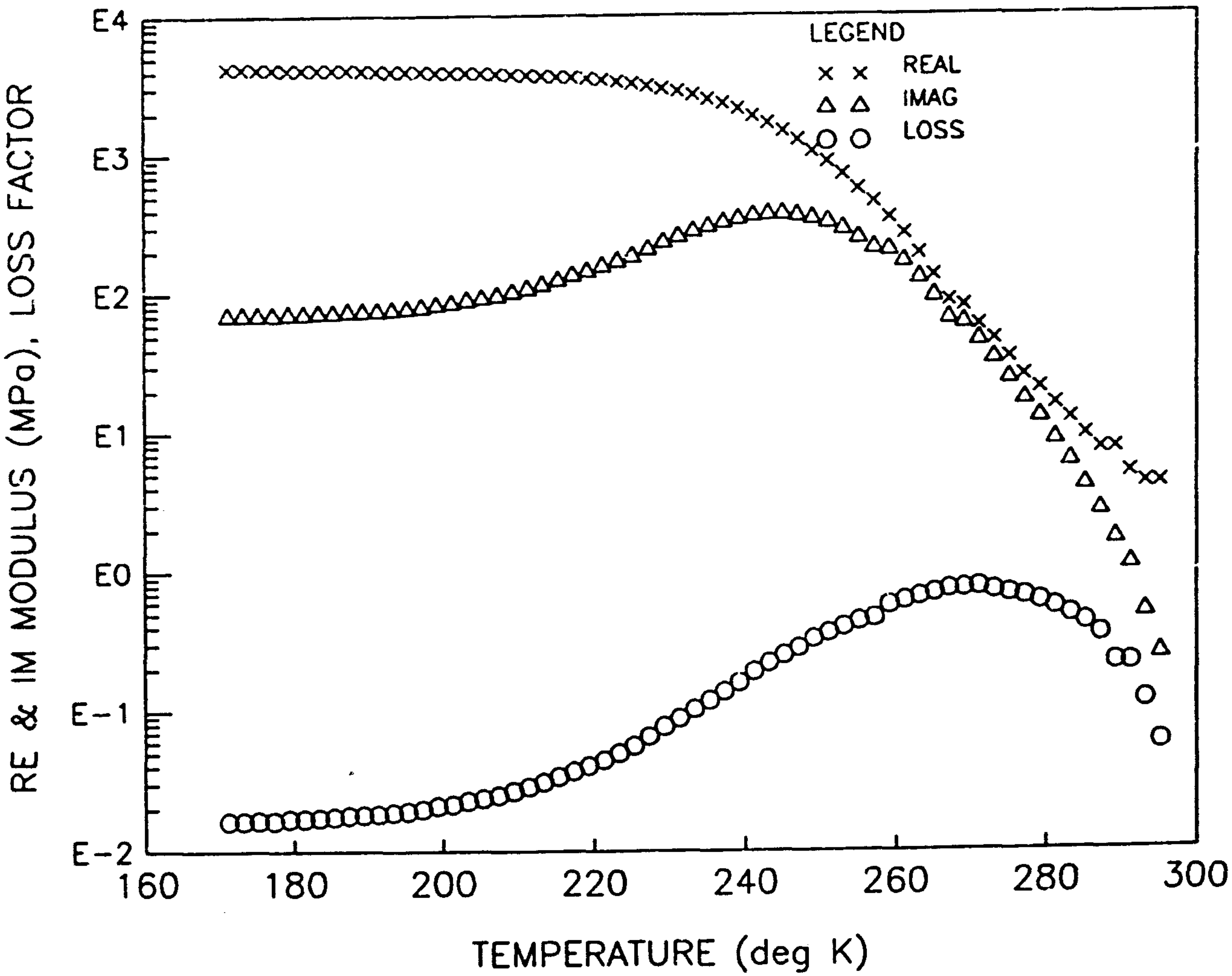


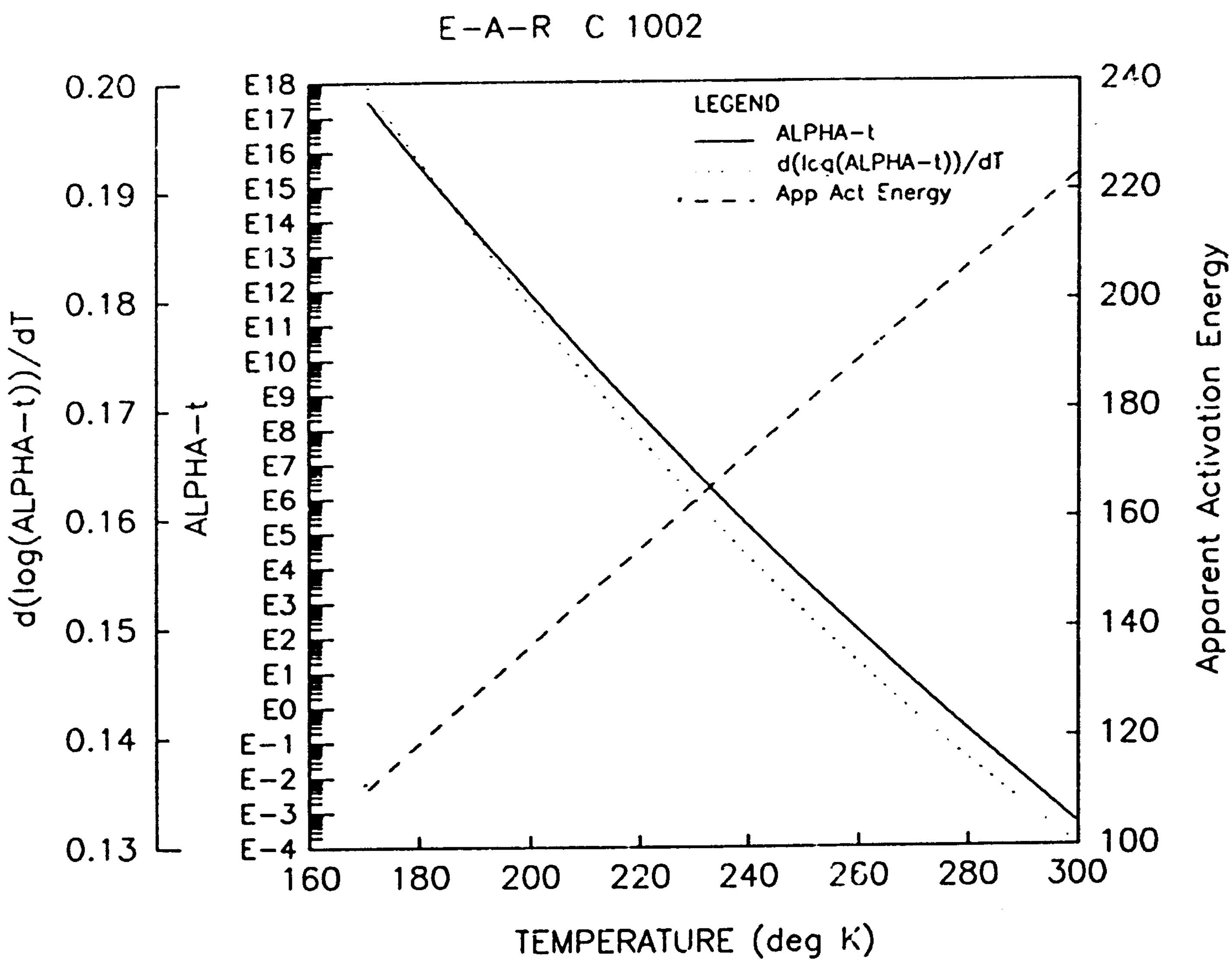

E-A-R C 1002
YOUNG'S
Temperature (deg F)
70 50 30 10 -10 -40 -70 -100 -130 -160
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E3
E2
E1
E0
E-1
E-2
E-3
FREQUENCY (Hz)
E5
E4
E3
E2
E1
E0
E-1
E-5 E-4 E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24
REDUCED FREQUENCY (Hz)


E–A–R C 1002
FREQUENCY (Hz)
E0
E1
E2
160
180
200
220
240
260
280
300
TEMPERATURE (deg K)
−160
−140
−120
−100
−80
−60
−40
−20
0
20
40
60
80
TEMPERATURE (deg F)


E-A-R C 1002
LOSS FACTOR
E0
E-1
E-2
MAGNITUDE MODULUS (MPa)
E0
E1
E2
E3
E4

E-A-R C 1C02


LEGEND
REAL
IMAG
LOSS
E4
E3
E2
E1
E0
E-1
E-2
RE & IM MODULUS (MPa), LOSS FACTOR
160
180
200
220
240
260
280
300
TEMPERATURE (deg K)


E-A-R C 1002
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
ALPHA-t
E18
E17
E16
E15
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
Apparent Activation Energy
240
220
200
180
160
140
120
100
160
180
200
220
240
260
280
300
TEMPERATURE (deg K)

ALPA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	275.0	170.0	300.0	0.1400	0.2000	0.1300

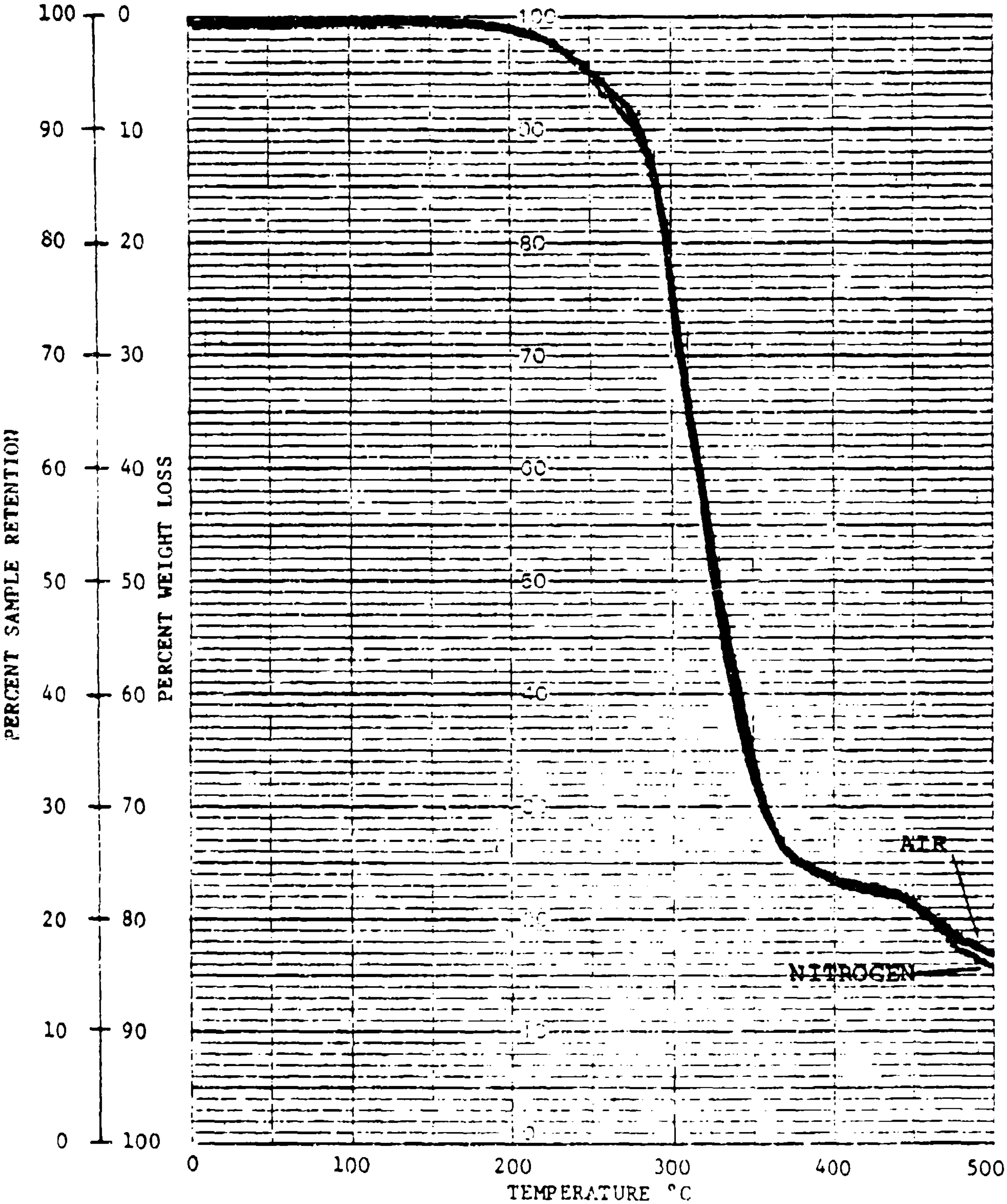
COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	5.000	4300.	0.1000E+06	0.5000	0.9000	0.1000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
171.2	18.90	4220.	0.1650E-01	69.63
173.2	18.90	4220.	0.1650E-01	69.63
175.2	18.80	4180.	0.1670E-01	69.81
177.2	18.80	4180.	0.1670E-01	69.81
179.2	18.70	4140.	0.1720E-01	71.21
181.2	18.70	4140.	0.1720E-01	71.21
183.2	18.70	4140.	0.1740E-01	72.04
185.2	18.60	4090.	0.1770E-01	72.39
187.2	18.60	4090.	0.1810E-01	74.03
189.2	18.50	4050.	0.1830E-01	74.12
191.2	18.50	4040.	0.1850E-01	74.74
193.2	18.40	4000.	0.1900E-01	76.00
195.2	18.40	4000.	0.1940E-01	77.60
197.2	18.30	3960.	0.2010E-01	79.60
199.2	18.20	3910.	0.2110E-01	82.50
201.2	18.20	3910.	0.2170E-01	84.85
203.2	18.10	3870.	0.2290E-01	88.62
205.2	18.10	3850.	0.2390E-01	92.01
207.2	18.00	3820.	0.2510E-01	95.88
209.2	17.90	3770.	0.2690E-01	101.4
211.2	17.80	3730.	0.2880E-01	107.4
213.2	17.70	3690.	0.3110E-01	114.8
215.2	17.60	3640.	0.3410E-01	124.1
217.2	17.50	3600.	0.3710E-01	133.6
219.2	17.30	3520.	0.4080E-01	143.6
221.2	17.20	3480.	0.4470E-01	155.6
223.2	16.90	3370.	0.5010E-01	168.8
225.2	16.70	3260.	0.5630E-01	183.5
227.2	16.30	3120.	0.6600E-01	205.9
229.2	15.90	2970.	0.7750E-01	230.2
231.2	15.60	2840.	0.8860E-01	251.6
233.2	15.10	2670.	0.1030	275.0
235.2	14.60	2510.	0.1190	298.7
237.2	14.10	2330.	0.1380	321.5
239.2	13.50	2120.	0.1600	339.2
241.2	12.70	1870.	0.1910	357.2
243.2	12.00	1660.	0.2210	366.9
245.2	11.30	1460.	0.2510	366.5
247.2	10.50	1260.	0.2840	357.8
249.2	9.630	1040.	0.3290	342.2

Temp (DEG K)	Freq (HZ)	mReal (MPA)	Eta	MImag (MPA)
251.2	8.890	876.0	0.3630	318.0
253.2	8.100	715.0	0.4000	286.0
255.2	7.260	56C.0	0.4400	246.4
257.2	6.610	452.0	0.4610	208.4
259.2	5.950	352.0	0.5750	202.4
261.2	5.340	269.0	0.6170	166.0
263.2	4.700	192.0	0.6580	126.3
265.2	4.160	134.0	0.6960	93.26
267.2	3.660	87.40	0.7400	64.68
269.2	3.580	80.30	0.7490	60.14
271.2	3.320	59.10	0.7650	45.21
273.2	3.150	46.00	0.7180	33.03
275.2	3.000	34.50	0.6900	23.81
277.2	2.880	25.70	0.6560	16.86
279.2	2.800	20.50	0.6070	12.44
281.2	2.730	15.70	0.5500	8.635
283.2	2.670	12.40	0.4860	6.026
285.2	2.630	9.450	0.4260	4.026
287.2	2.600	7.560	0.3530	2.669
289.2	2.600	7.560	0.2200	1.663
291.2	2.560	5.020	0.2180	1.094
293.2	2.550	4.220	0.1170	0.4937
295.2	2.550	4.220	0.5870E-010.2477	



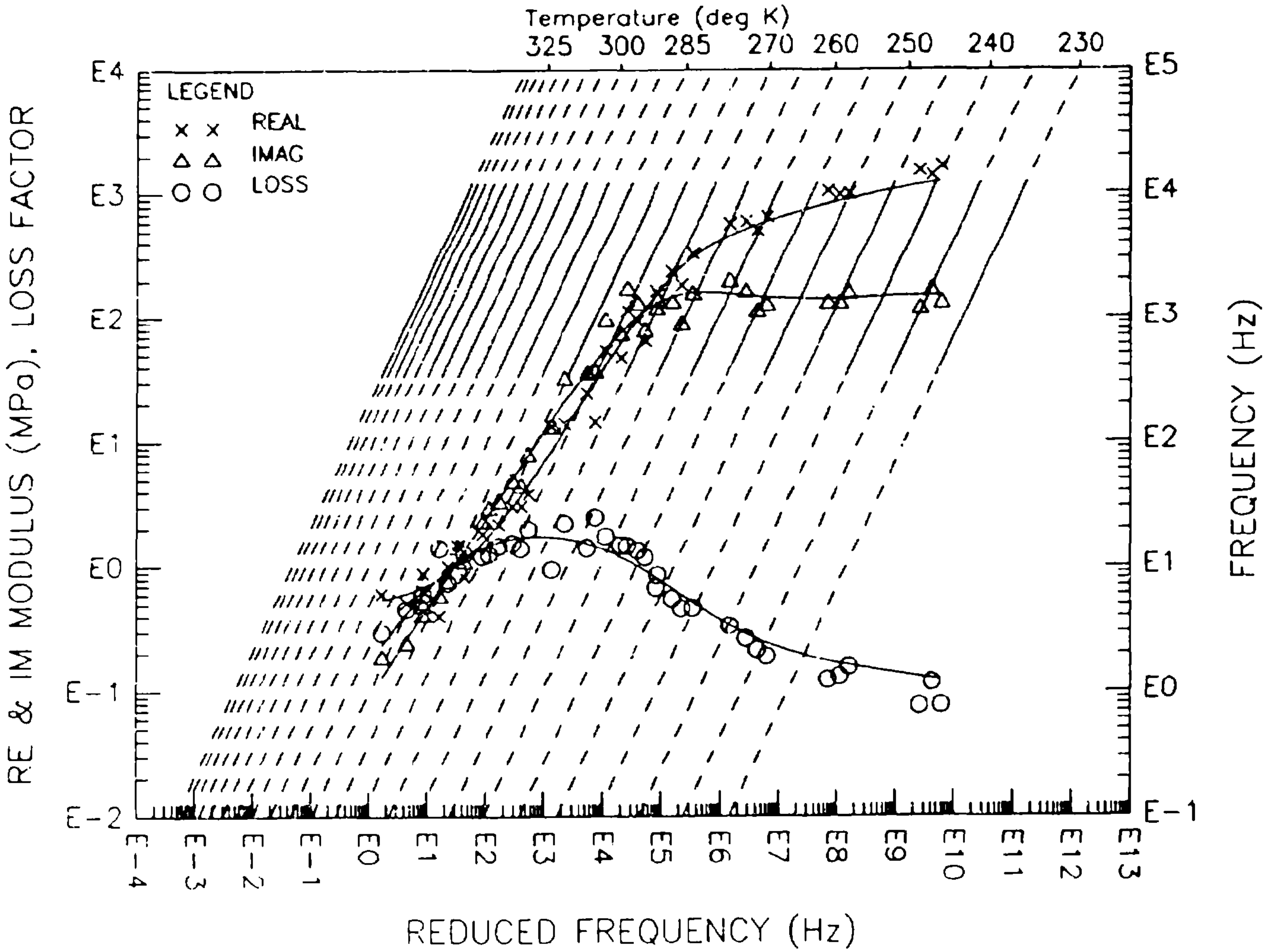
TGA of E-A-R Division's ISODAMP C-1002.

DYAD 601 SHEAR

		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1226	1.218	1.740	1.218	0.2341
MODULUS	MPA	1241.	65.34	6.462	1.189	0.5542
	PSI	0.1799E+06	9476.	937.2	172.4	80.37
	DEG K		257.0	269.0	282.0	
10.HZ	DEG C		-36.15	-24.15	-11.15	
	DEG F		-33.07	-11.47	11.93	
	DEG K		265.0	280.0	294.0	
100.HZ	DEG C		-28.15	-13.15	0.8500	
	DEG F		-18.67	8.330	33.53	
	DEG K		275.0	291.0	310.0	
1000.HZ	DEG C		-18.15	-2.150	16.85	
	DEG F		-.6700	28.13	62.33	

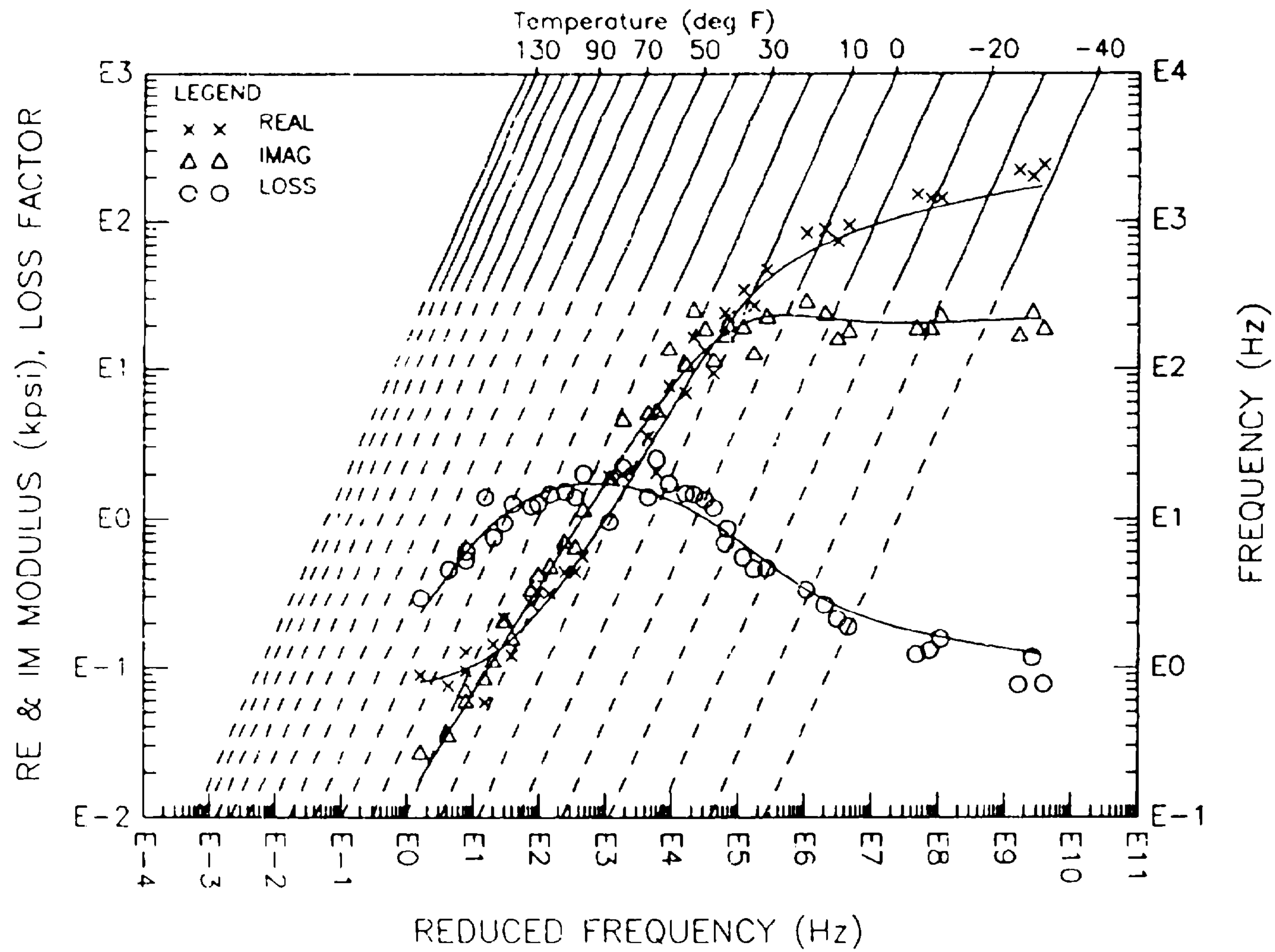
DYAD 601

SHEAR

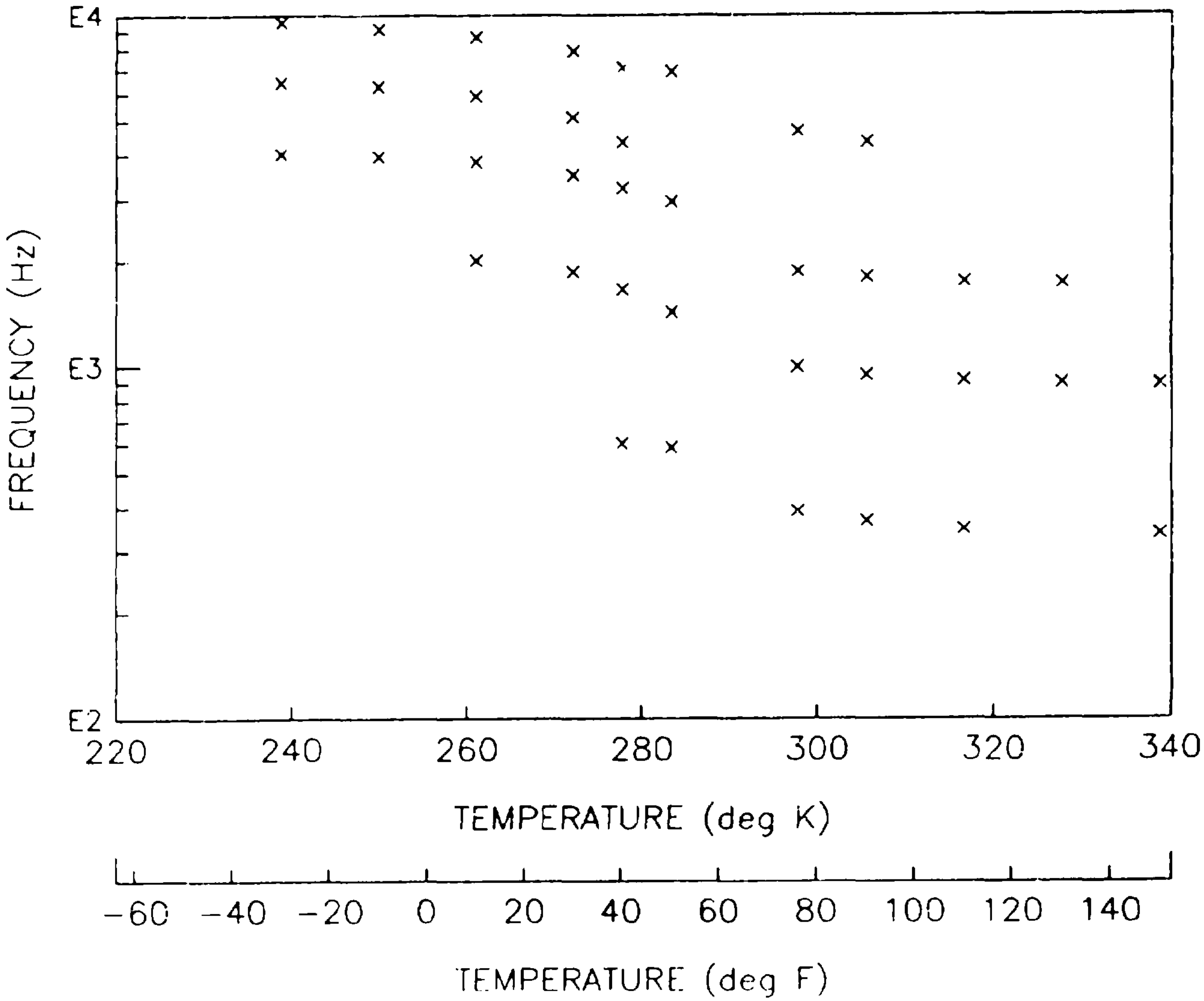


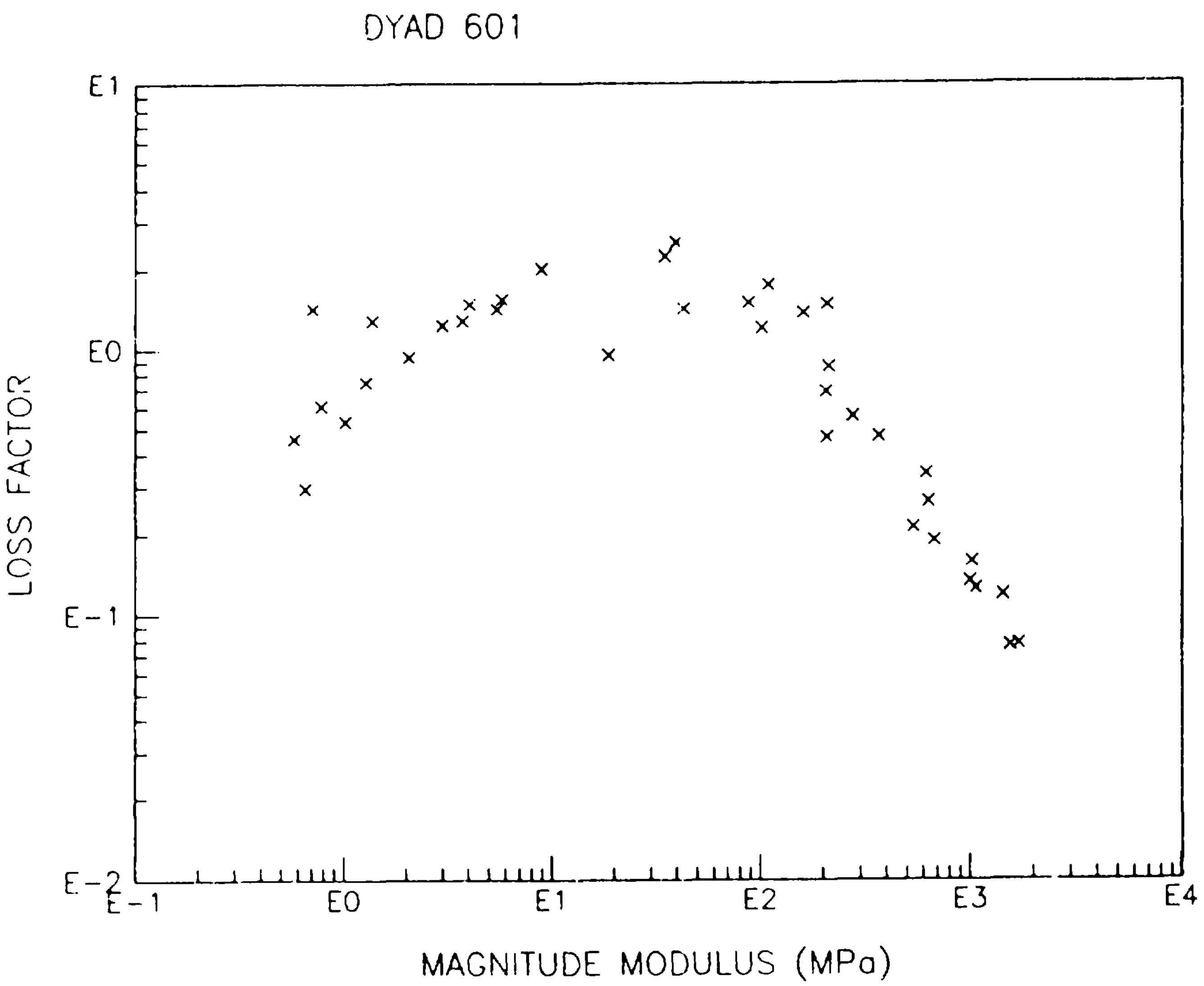
DYAD 601

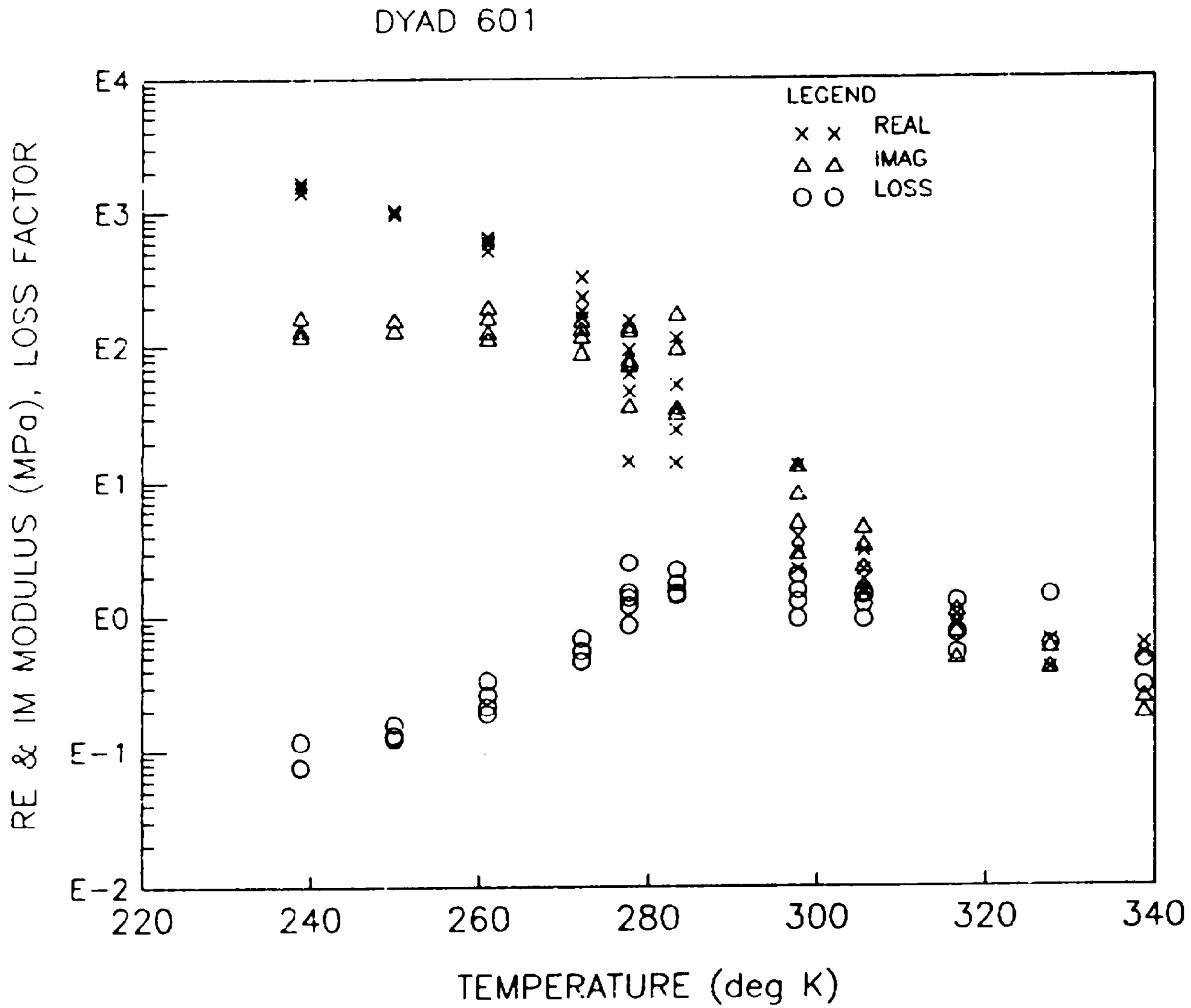
SHEAR

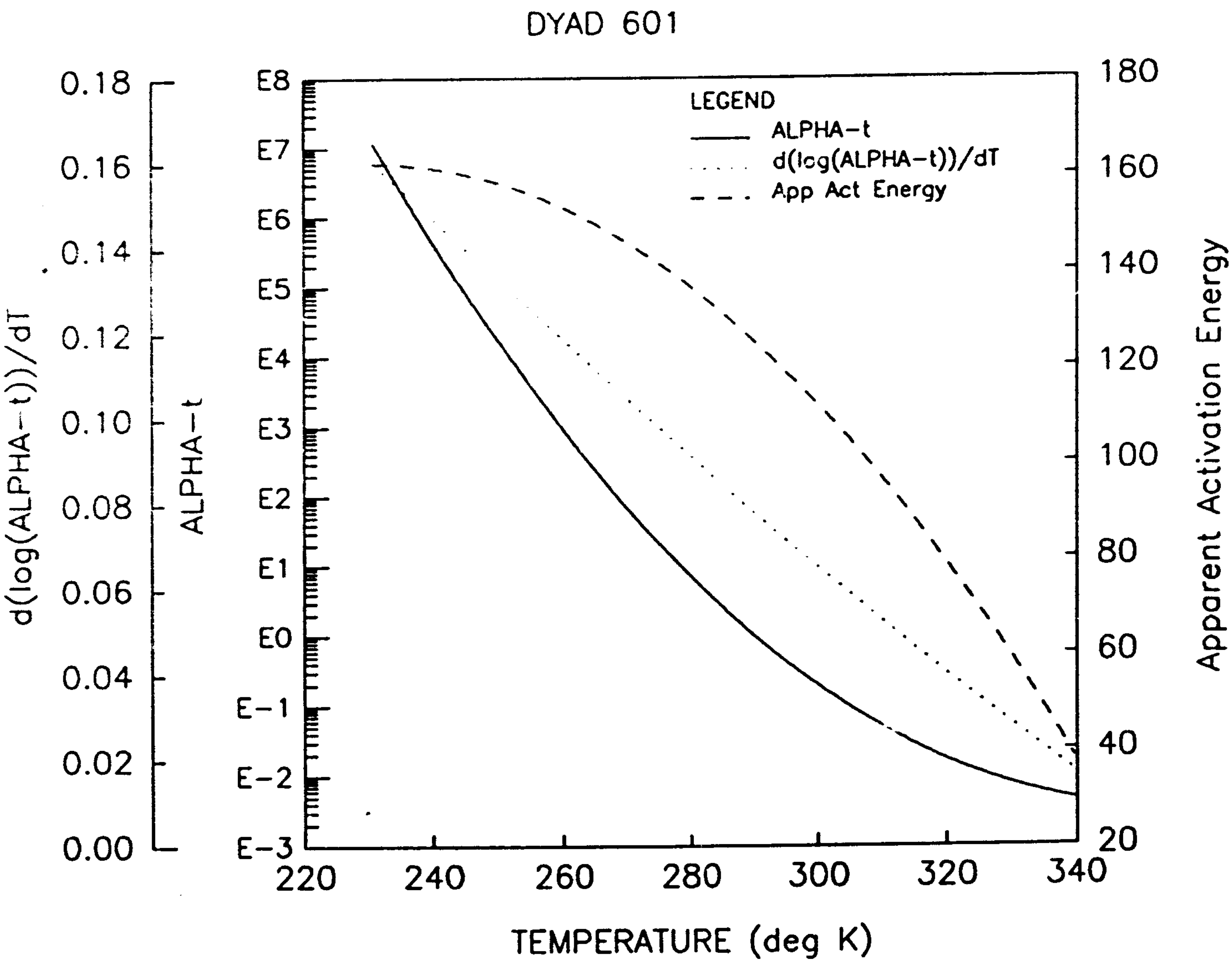


DYAD 601


E4
E3
E2
FREQUENCY (Hz)
220
240
260
280
300
320
340
TEMPERATURE (deg K)
-60
-40
-20
0
20
40
60
80
100
120
140
TEMPERATURE (deg F)


DYAD 601
LOSS FACTOR
E1
E0
E-1
E-2
E-1
E0
E1
E2
E3
E4
MAGNITUDE MODULUS (MPa)


DYAD 601
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
E−1
E−2
220
240
260
280
300
320
340
TEMPERATURE (deg K)


DYAD 601
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
ALPHA-t
Apparent Activation Energy
TEMPERATURE (deg K)
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
180
160
140
120
100
80
60
40
20
220
240
260
280
300
320
340

DYAD 601 SHEAR

ALFA-T MODEL

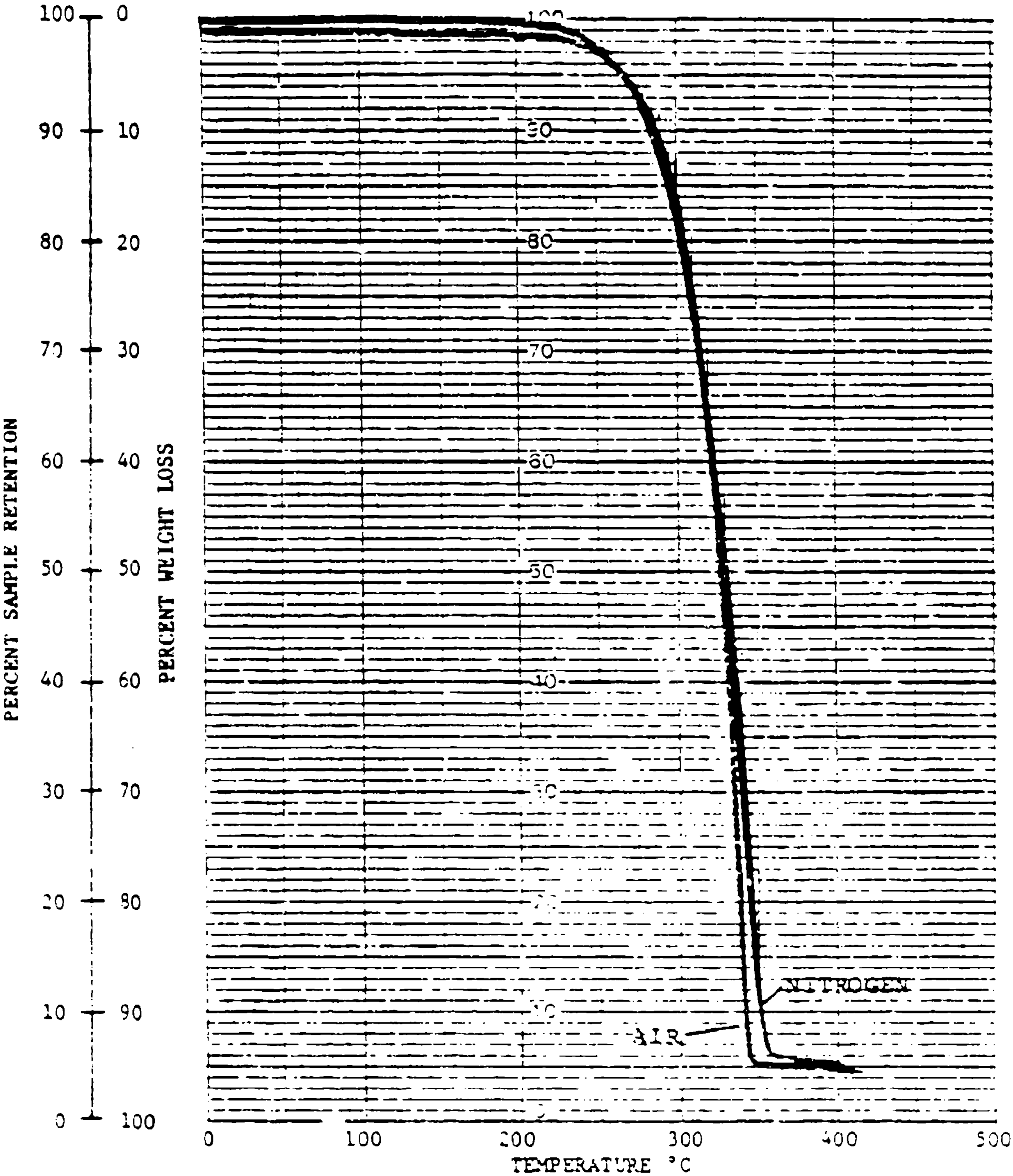
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	290.0	230.0	340.0	0.7795E-01	0.1607	0.1694E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.4932	2585.	0.1284E+07	0.7211	3.782	0.1483

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
338.7	335.3	0.6167	0.2962	0.1827
338.7	890.6	0.5182	0.4601	0.2384
327.6	898.0	0.6567	0.6076	0.3990
327.6	1730.	0.4036	1.413	0.5703
316.5	346.2	0.8867	0.5336	0.4731
316.5	913.5	1.007	0.7479	0.7531
316.5	1751.	0.8391	1.273	1.068
305.4	367.1	1.480	0.9392	1.390
305.4	947.1	1.856	1.221	2.266
305.4	1804.	2.212	1.479	3.272
305.4	4372.	3.090	1.412	4.363
297.6	391.9	2.257	1.275	2.878
297.6	994.7	3.074	1.547	4.755
297.6	1871.	3.876	2.019	7.826
297.6	4686.	13.33	0.9568	12.75
283.2	587.0	13.97	2.229	31.14
283.2	1430.	24.39	1.416	34.54
283.2	2960.	53.11	1.751	93.00
283.2	6930.	114.9	1.475	169.5
277.6	603.6	14.31	2.504	35.83
277.6	1560.	48.05	1.495	71.83
277.6	3230.	93.91	1.360	127.7
277.6	4353.	64.34	1.196	76.95
277.6	7071.	158.6	0.8630	136.9
272.0	1868.	167.2	0.6871	114.9
272.0	3508.	237.0	0.5552	131.6
272.0	5129.	185.2	0.4641	85.95
272.0	7905.	326.7	0.4692	153.3
260.9	2019.	577.0	0.3359	193.8
260.9	3816.	607.6	0.2639	160.3
260.9	5928.	514.7	0.2134	109.8
260.9	8680.	651.5	0.18[illegible]4	123.4
249.8	3946.	1039.	0.1240	128.8
249.8	6294.	971.5	0.1320	128.2
249.8	9121.	987.4	0.1570	155.0
238.7	4023.	1529.	0.7615E-01	116.4
238.7	6478.	1394.	0.1175	163.8
238.7	9552.	1668.	0.7717E-01	128.7



PERCENT SAMPLE RETENTION
PERCENT WEIGHT LOSS
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
100
NITROGEN
AIR
0
100
200
300
400
500
TEMPERATURE °C

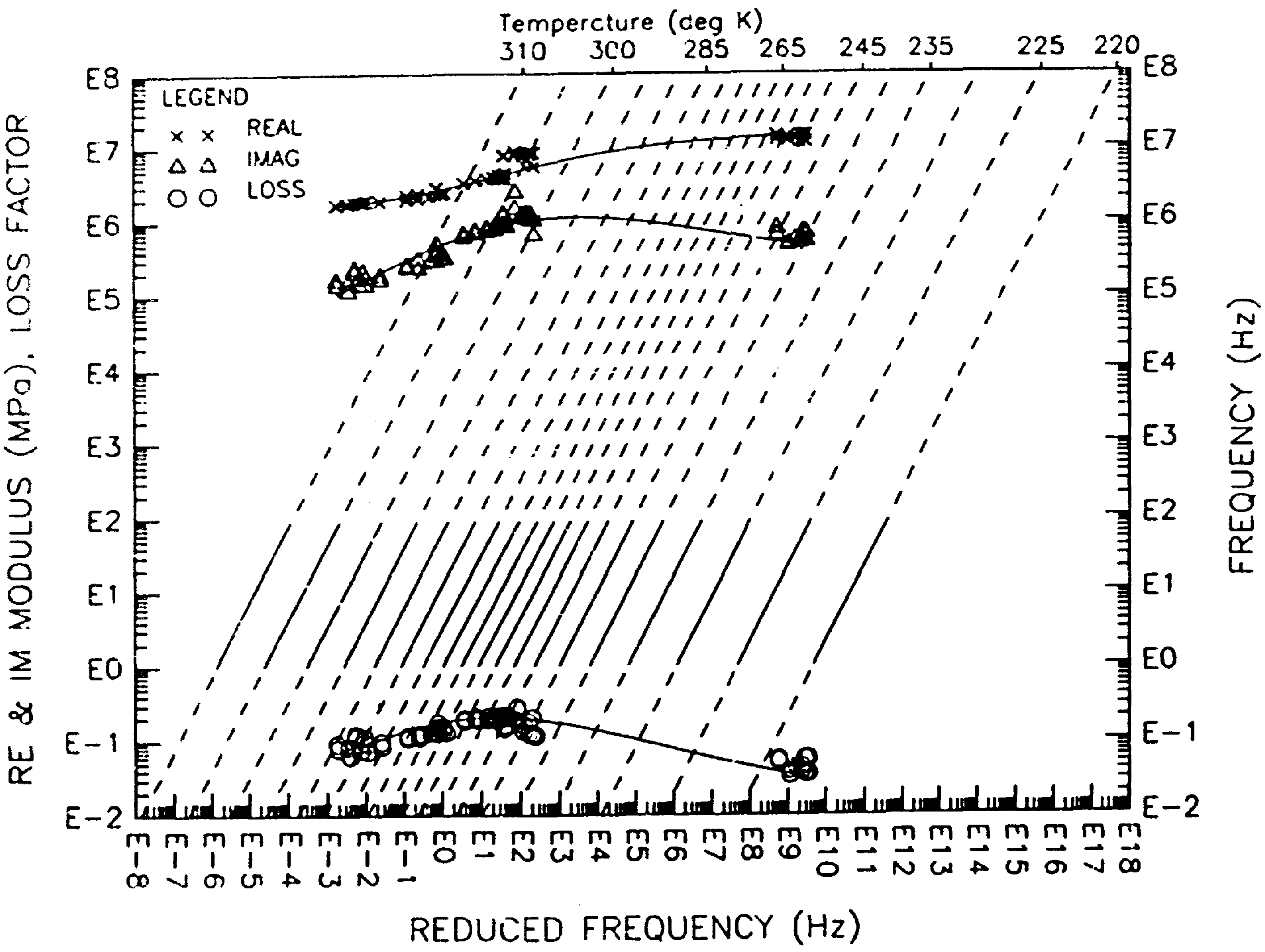
3M AF-40

YOUNG'S

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.2060E-01	0.1439	0.2055	0.1439	0.6057E-01
MODULUS	MPA	0.1436E+08	0.7883E+07	0.3944E+07	0.2263E+07	0.1718E+07
	PSI	0.2083E+10	0.1143E+10	0.5720E+09	0.3282E+09	0.24[illegible]1E+09
10.HZ	DEG K		246.0	272.0	296.0	
	DEG C		-47.15	-21.15	-3.150	
	DEG F		-52.87	-6.070	26.33	
100.HZ	DEG K		254.0	281.0	296.0	
	DEG C		-39.15	-12.15	2.850	
	DEG F		-38.47	10.13	37.13	
1000.HZ	DEG K		266.0	289.0	301.0	
	DEG C		-27.15	-4.150	7.850	
	DEG F		-16.87	24.53	46.13	

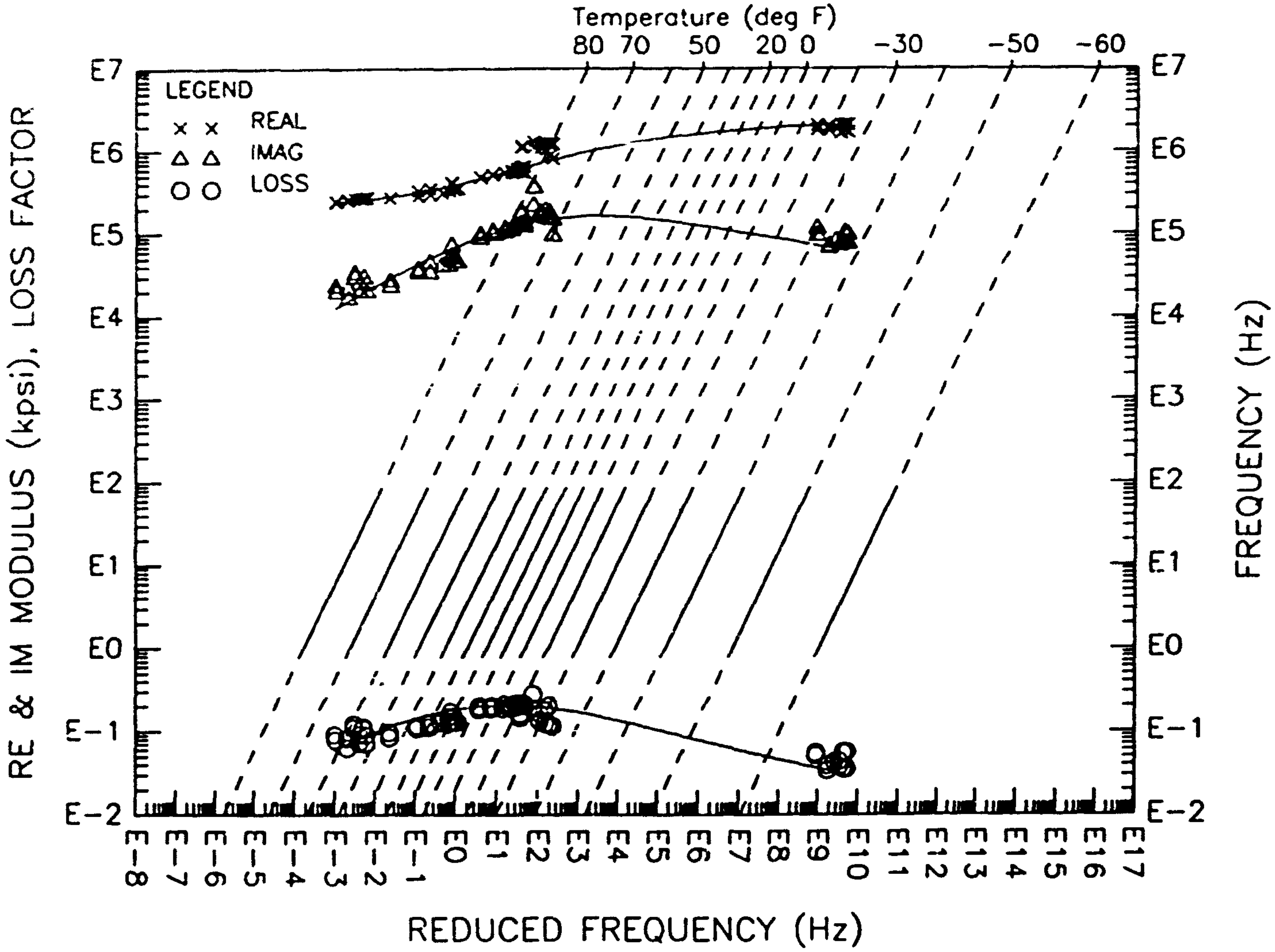
3M AF-40

YOUNG'S

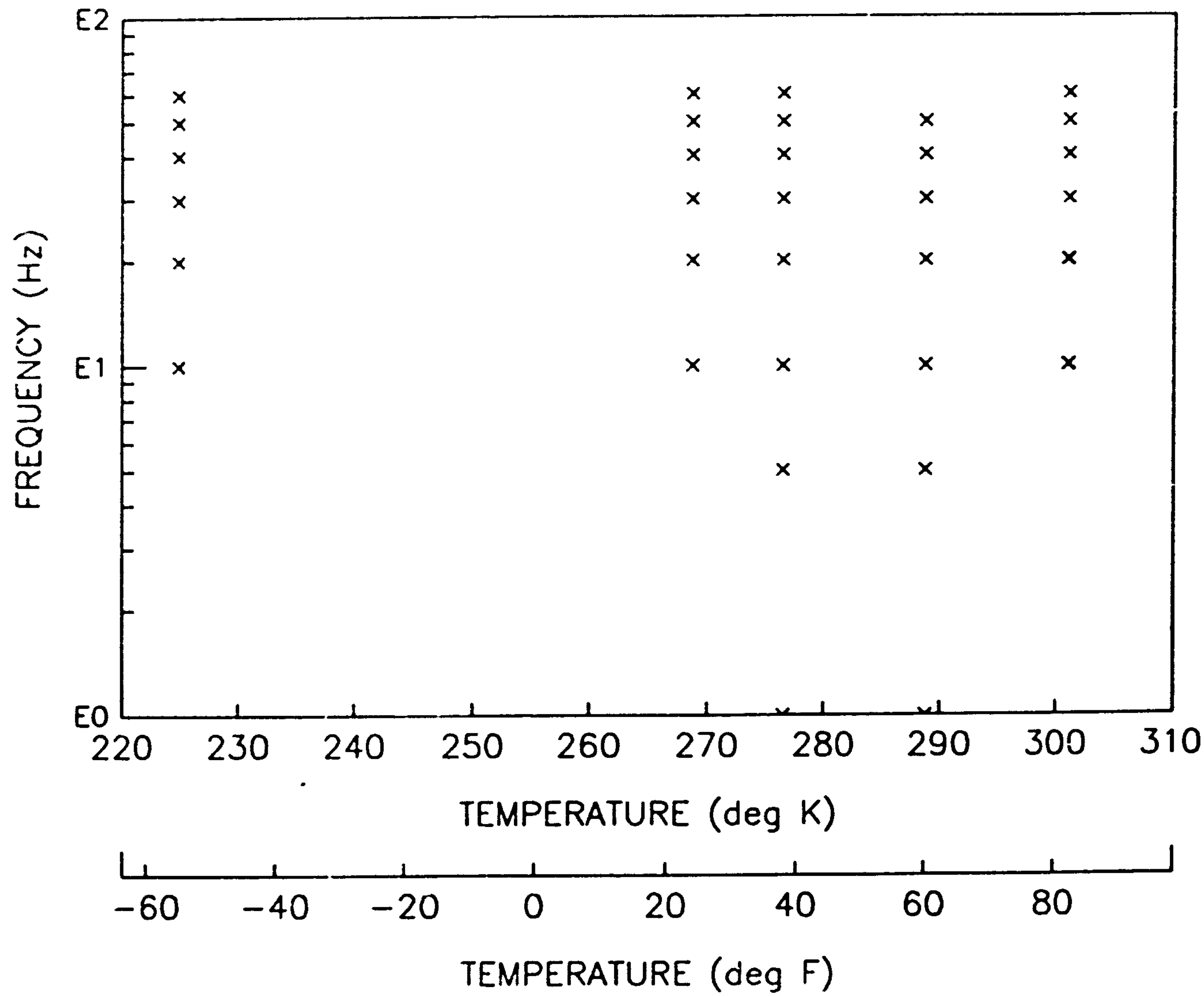


3M AF-40

YOUNG'S

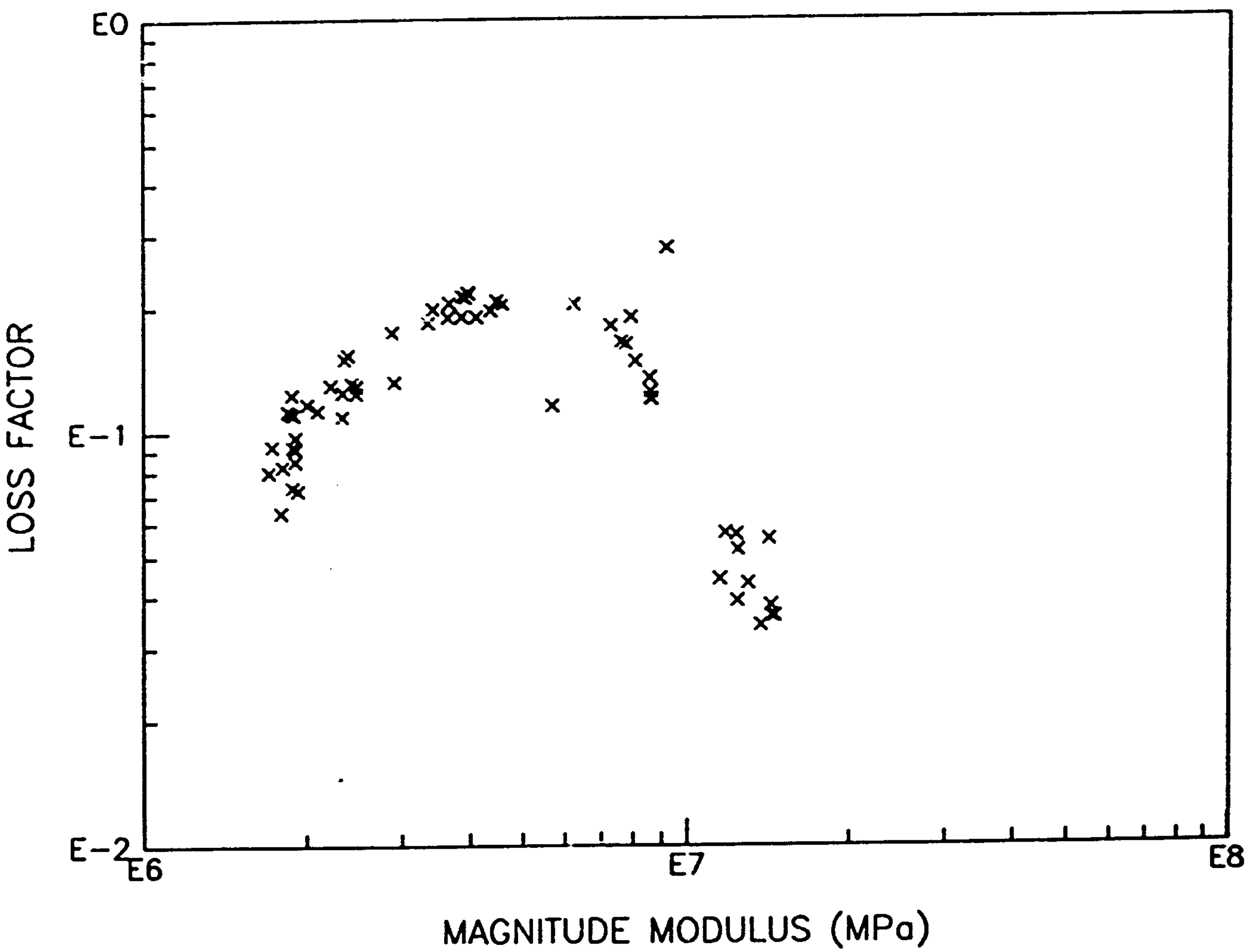


3M AF-40

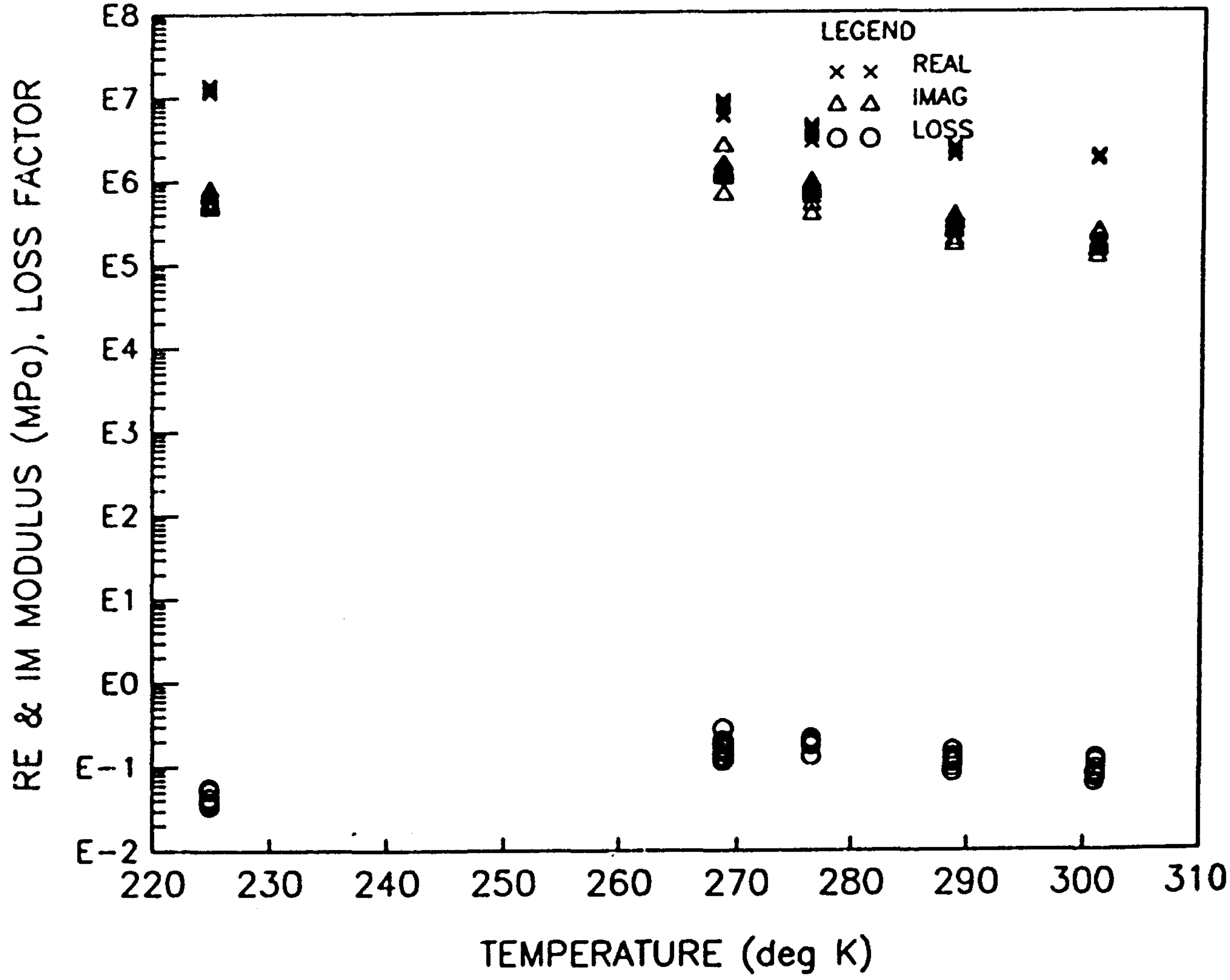


E2
E1
E0
FREQUENCY (Hz)
220
230
240
250
260
270
280
290
300
310
TEMPERATURE (deg K)
-60
-40
-20
0
20
40
60
80
TEMPERATURE (deg F)

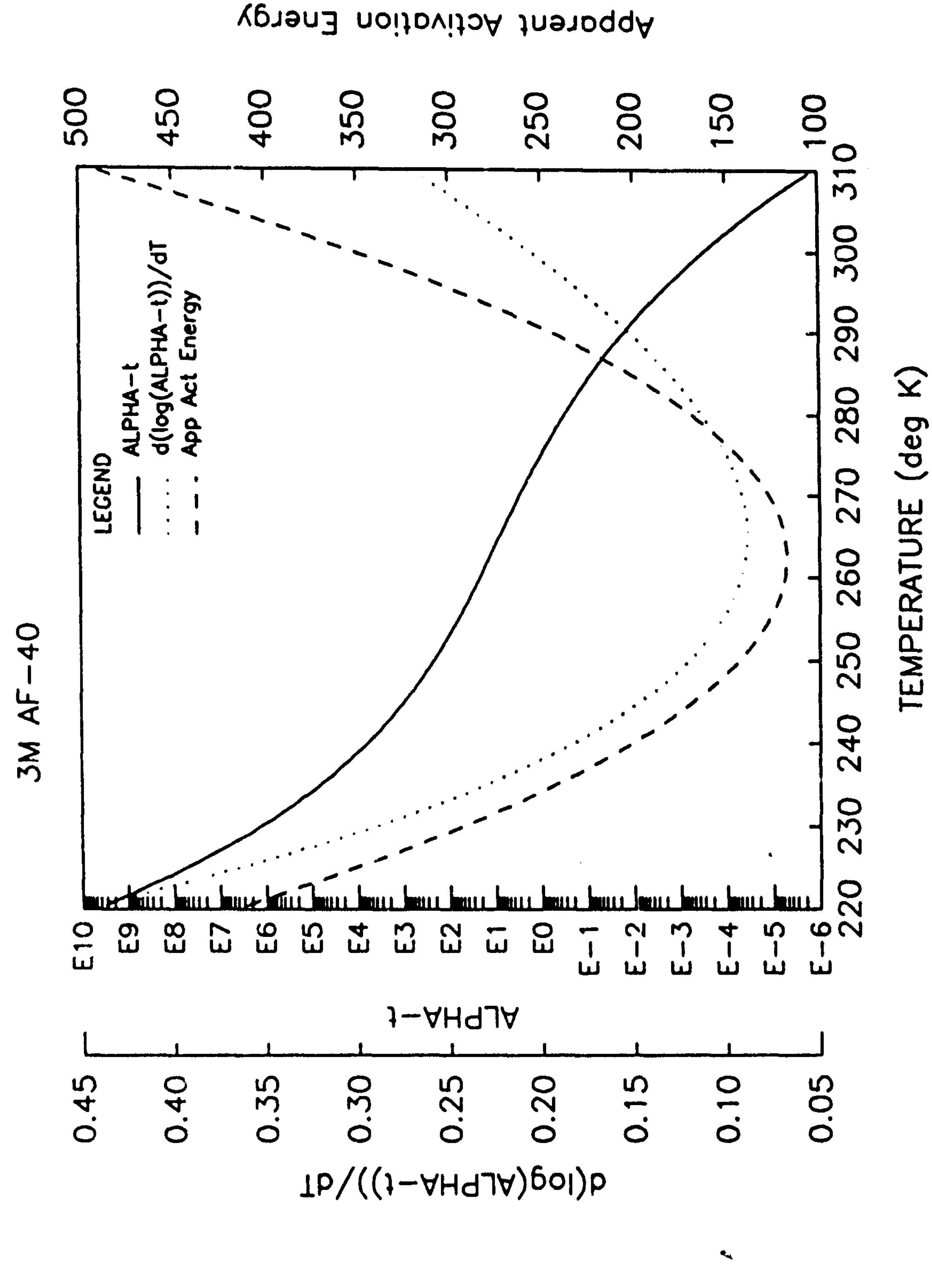
3M AF-40



3M AF-40



LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
220
230
240
250
260
270
280
290
300
310
TEMPERATURE (deg K)


3M AF-40
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
220 230 240 250 260 270 280 290 300 310
ALPHA-t
E10 E9 E8 E7 E6 E5 E4 E3 E2 E1 E0 E-1 E-2 E-3 E-4 E-5 E-6
d(log(ALPHA-t))/dT
0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05
Apparent Activation Energy
500 450 400 350 300 250 200 150 100

3M AF-40 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	275.0	220.0	310.0	0.1000	0.4500	0.2700

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.1500E+07	0.1600E+08	1600.	0.3000	1.000	0.1000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

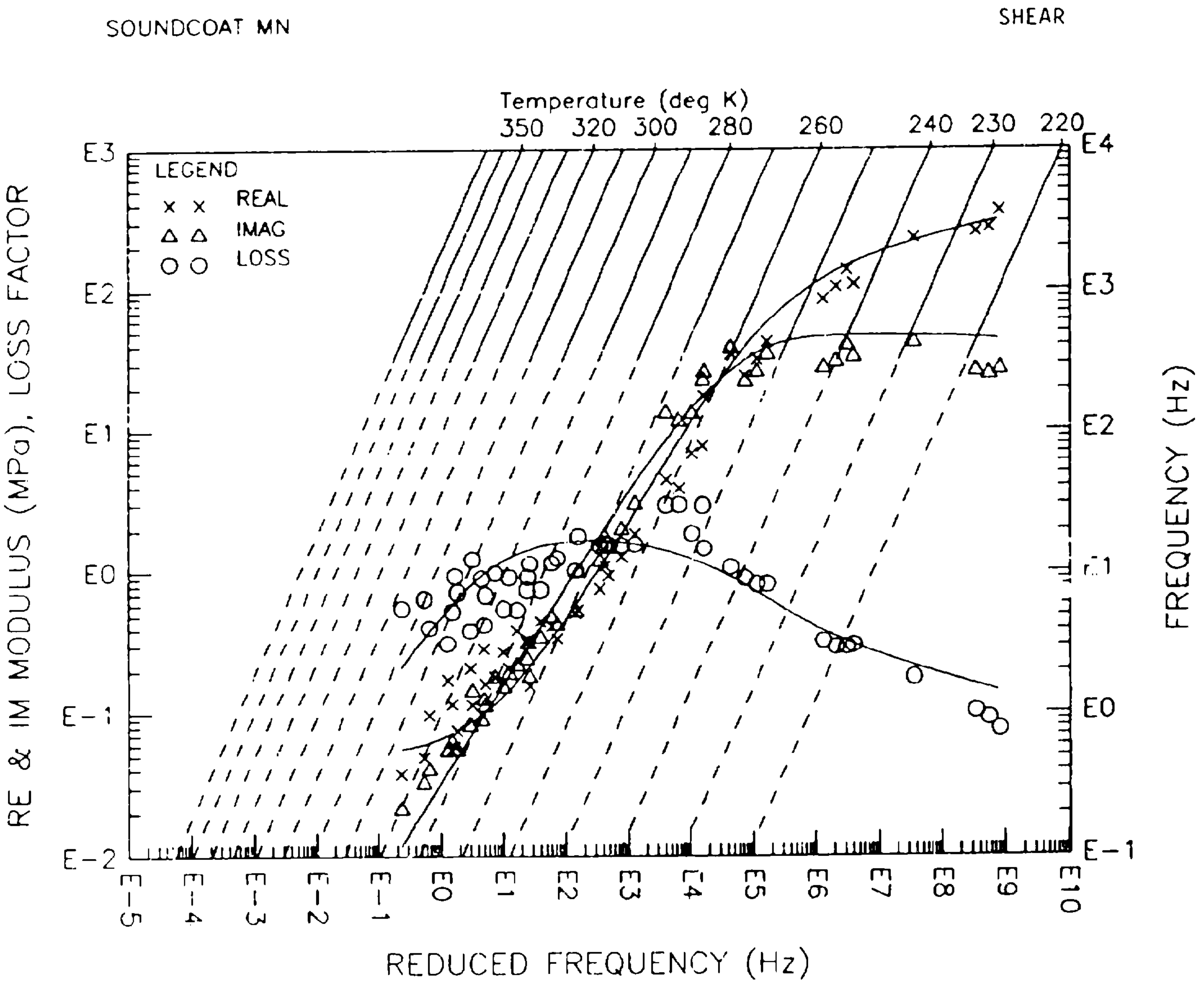
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
288.7	5.000	0.1983E+07	0.1170	0.2320E+06
288.7	10.00	0.2074E+07	0.1129	0.2342E+06
288.7	20.00	0.2188E+07	0.1299	0.2842E+06
288.7	30.00	0.2304E+07	0.1248	0.2875E+06
288.7	40.00	0.2398E+07	0.1312	0.3146E+06
288.7	50.00	0.2445E+07	0.1293	0.3161E+06
288.7	1.000	0.1893E+07	0.9720E-01	0.1840E+06
288.7	5.000	0.2304E+07	0.1092	0.2516E+06
288.7	10.00	0.2445E+07	0.1243	0.3039E+06
288.7	30.00	0.2316E+07	0.1504	0.3483E+06
288.7	40.00	0.2351E+07	0.1538	0.3616E+06
300.9	10.00	0.1693E+07	0.7980E-01	0.1351E+06
300.9	20.00	0.1782E+07	0.6380E-01	0.1137E+06
301.0	30.00	0.1849E+07	0.1115	0.2062E+06
301.0	40.00	0.1871E+07	0.7350E-01	0.1375E+06
301.0	50.00	0.1826E+07	0.1126	0.2056E+06
301.0	60.00	0.1915E+07	0.7210E-01	0.1381E+06
301.0	10.00	0.1715E+07	0.9220E-01	0.1581E+06
301.0	20.00	0.1793E+07	0.8250E-01	0.1479E+06
301.0	30.00	0.1860E+07	0.1233	0.2293E+06
301.0	40.00	0.1871E+07	0.9200E-01	0.1721E+06
301.0	50.00	0.1871E+07	0.1104	0.2066E+06
301.0	60.00	0.1893E+07	0.9110E-01	0.1725E+06
224.8	20.00	0.1234E+08	0.3890E-01	0.4800E+06
224.8	30.00	0.1292E+08	0.4290E-01	0.5543E+06
224.8	40.00	0.1145E+08	0.4390E-01	0.5027E+06
224.8	50.00	0.1229E+08	0.5620E-01	0.6907E+06
224.8	60.00	0.1173E+08	0.5680E-01	0.6663E+06
224.8	10.00	0.1412E+08	0.5500E-01	0.7766E+06
224.8	20.00	0.1365E+08	0.3400E-01	0.4641E+06
224.8	10.00	0.1238E+08	0.5180E-01	0.6413E+06
224.8	40.00	0.1426E+08	0.3800E-01	0.5419E+06
224.8	50.00	0.1450E+08	0.3580E-01	0.5191E+06
224.8	60.00	0.1431E+08	0.3590E-01	0.5137E+06
268.7	10.00	0.7978E+07	0.1478	0.1179E+07
268.7	20.00	0.8874E+07	0.2784	0.2471E+07
268.7	30.00	0.8495E+07	0.1347	0.1144E+07
268.7	40.00	0.8529E+07	0.1248	0.1064E+07
268.7	50.00	0.8570E+07	0.1198	0.1027E+07
268.7	60.00	0.8529E+07	0.1200	0.1023E+07

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
268.7	10.00	0.7660E+07	0.1629	0.1248E+07
268.7	20.00	0.7798E+07	0.1895	0.1478E+07
268.7	30.00	0.7502E+07	0.1643	0.1233E+07
268.7	40.00	0.7157E+07	0.1807	0.1293E+07
268.7	50.00	0.6094E+07	0.2033	0.1239E+07
268.7	60.00	0.5629E+07	0.1154	0.6496E+06
276.4	1.000	0.2877E+07	0.1322	0.3803E+06
276.4	5.000	0.3299E+07	0.1844	0.6083E+06
276.4	10.00	0.3881E+07	0.1897	0.6793E+06
276.4	20.00	0.3789E+07	0.1901	0.7203E+06
276.4	30.00	0.4029E+07	0.1898	0.7647E+06
276.4	40.00	0.4273E+07	0.1966	0.8401E+06
276.4	50.00	0.4383E+07	0.2071	0.9077E+06
276.4	60.00	0.4494E+07	0.2040	0.9168E+06
276.4	5.000	0.3350E+07	0.1985	0.6650E+06
276.4	10.00	0.3581E+07	0.2051	0.7345E+06
276.4	20.00	0.3776E+07	0.2128	0.8035E+06
276.4	30.00	0.3829E+07	0.2109	0.8075E+06
276.4	40.00	0.3869E+07	0.2168	0.8388E+06
276.4	50.00	0.3882E+07	0.2163	0.8397E+06
276.4	60.00	0.3882E+07	0.2163	0.8397E+06
288.7	1.000	0.1893E+07	0.8500E-01	0.1609E+06
276.4	1.000	0.2828E+07	0.1743	0.4929E+06

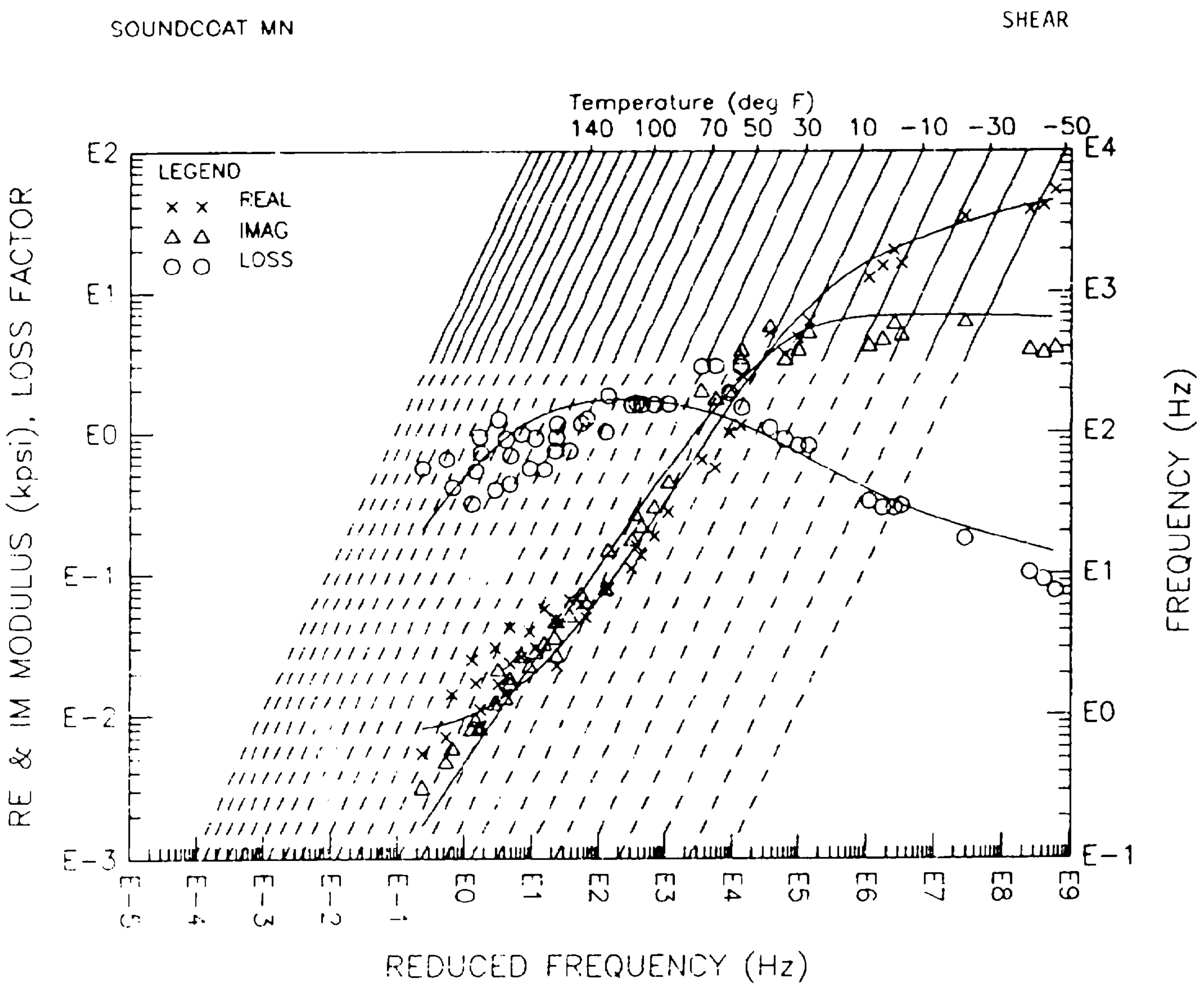
SOUNDCOAT MN

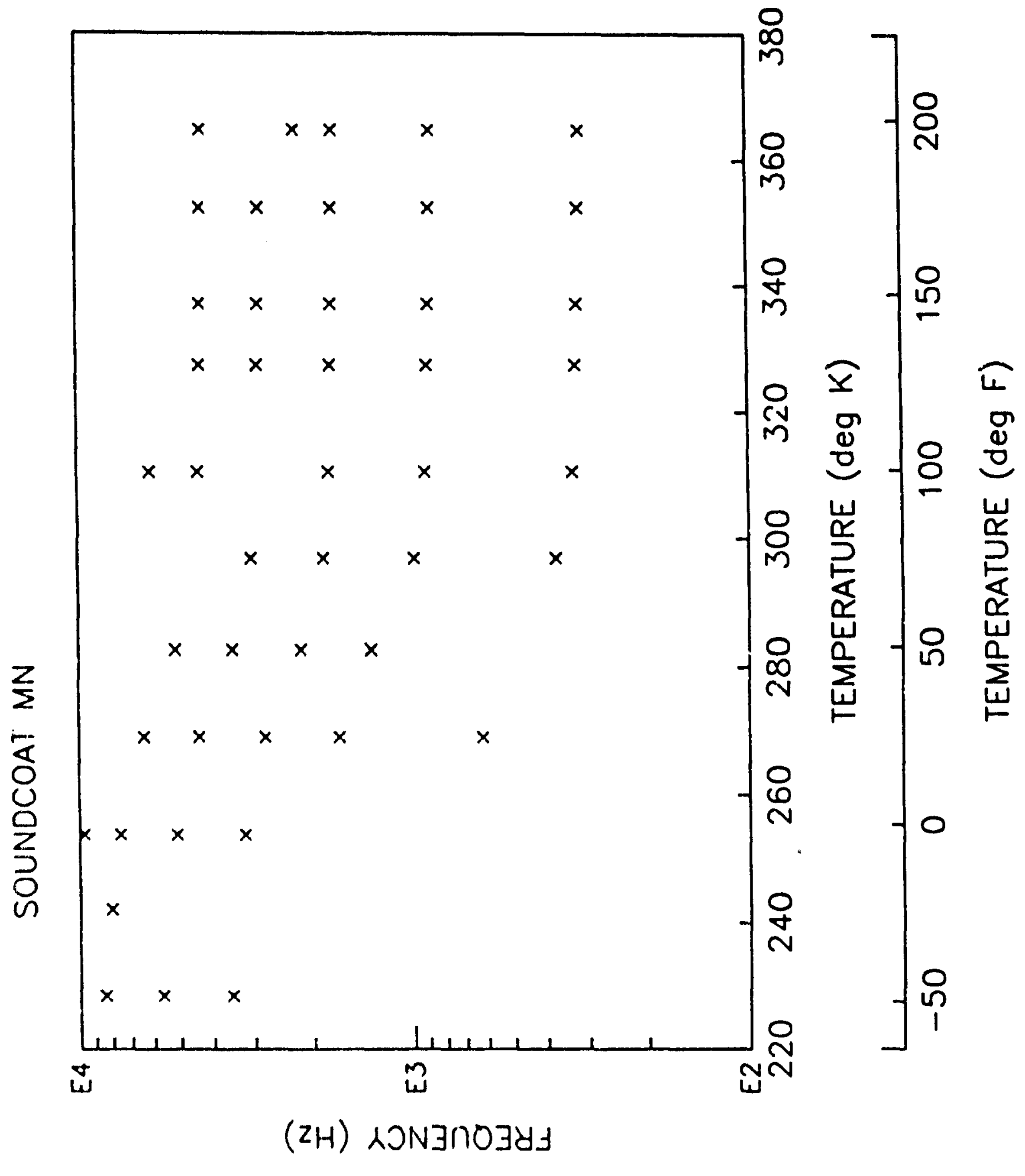
SHEAR

		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1419	1.183	1.690	1.183	0.2096
MODULUS	MPA	309.9	15.22	0.8783	0.1356	0.5600E-01
	PSI	0.4494E+05	2208.	127.4	19.67	8.121
10.HZ	DEG K		247.0	269.0	290.0	
	DEG C		-46.15	-24.15	-3.150	
	DEG F		-51.07	-11.47	26.33	
100.HZ	DEG K		259.0	284.0	309.0	
	DEG C		-34.15	-9.150	15.85	
	DEG F		-29.47	15.53	60.53	
1000.HZ	DEG K		273.0	301.0	331.0	
	DEG C		-20.15	7.850	37.85	
	DEG F		-4.270	46.13	100.1	

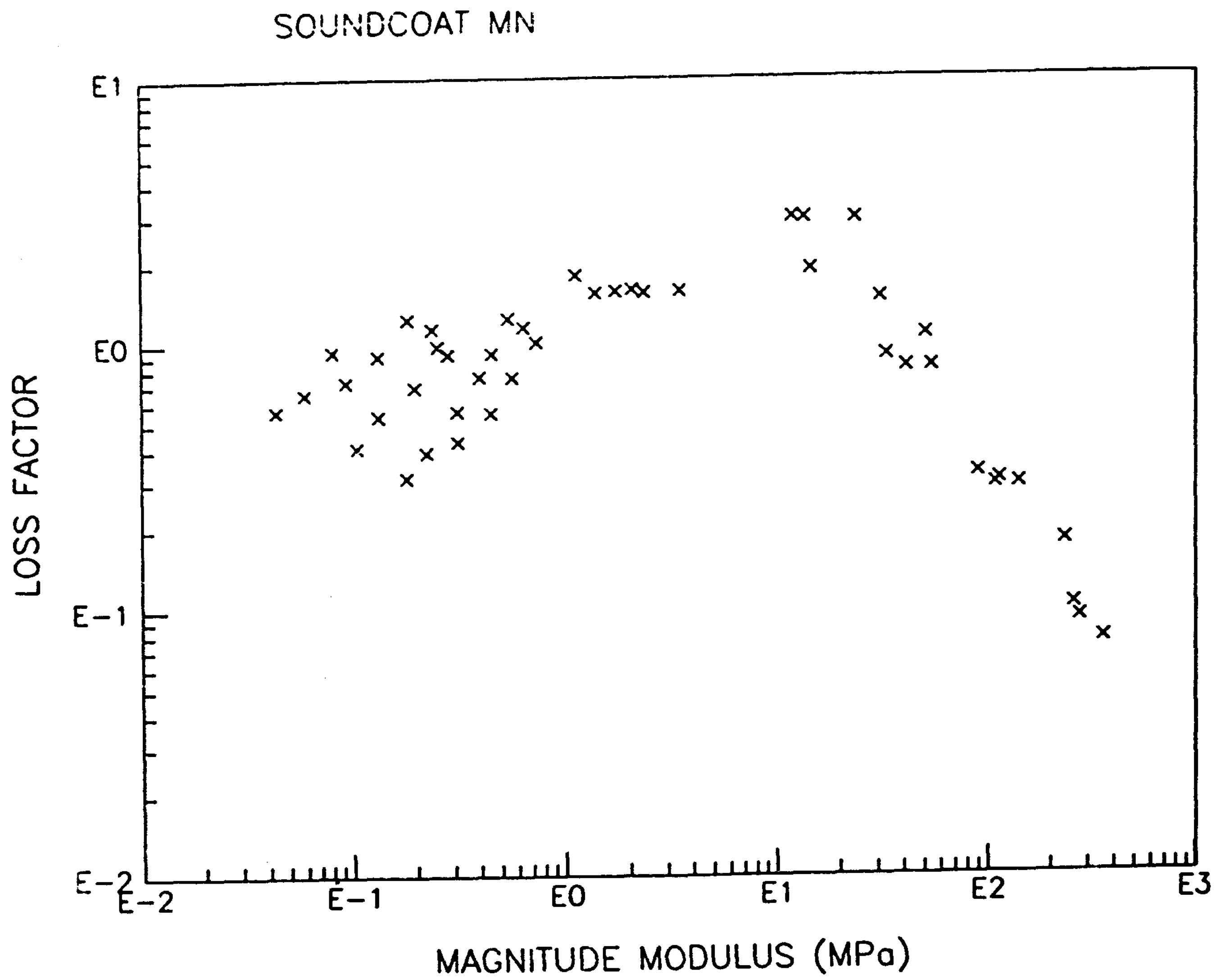


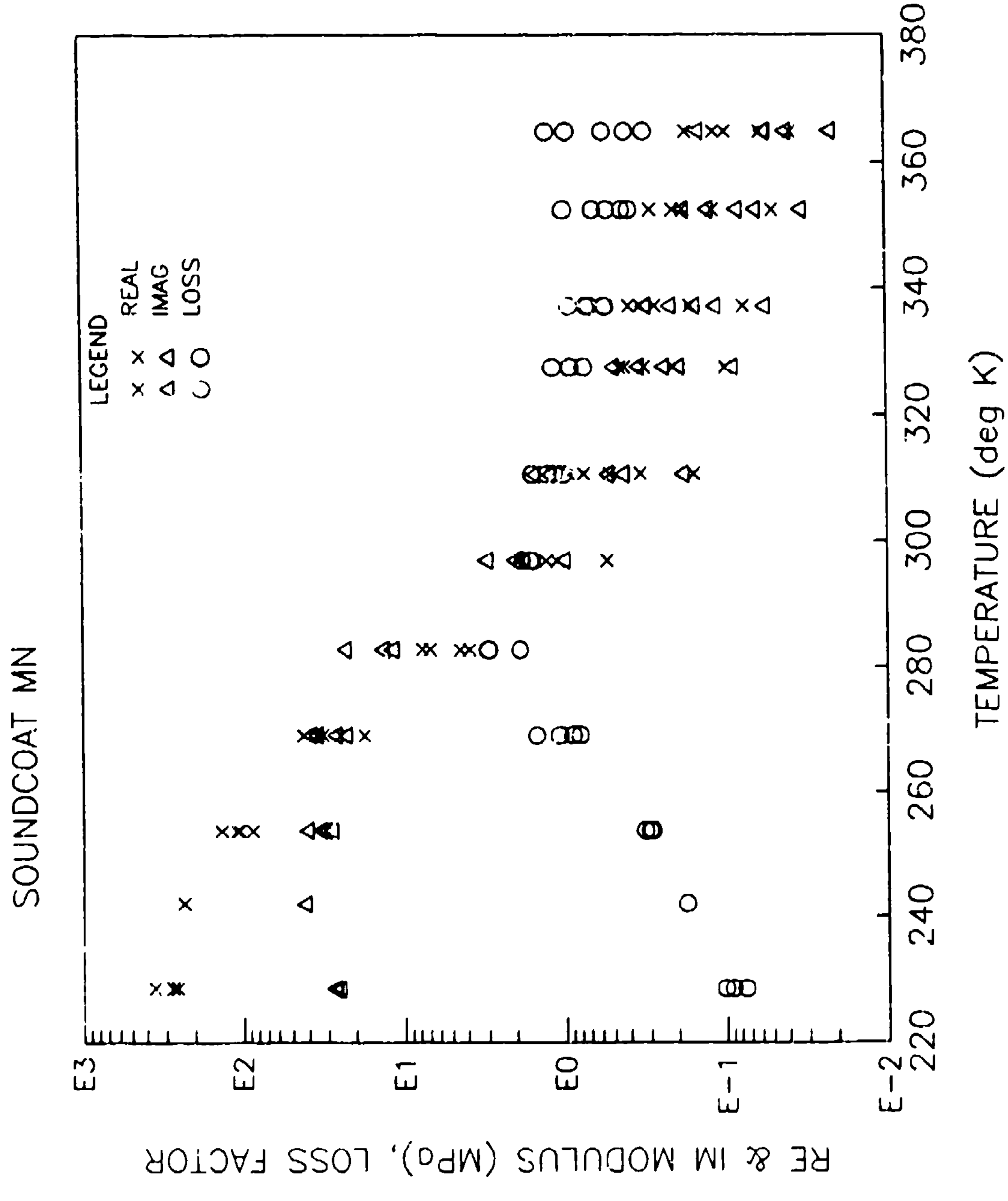
SOUNDCOAT MN
SHEAR
Temperature (deg K)
350 320 300 280 260 240 230 220
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E-1
E-2
REDUCED FREQUENCY (Hz)
E-5 E-4 E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10
FREQUENCY (Hz)
E4
E3
E2
E1
E0
E-1

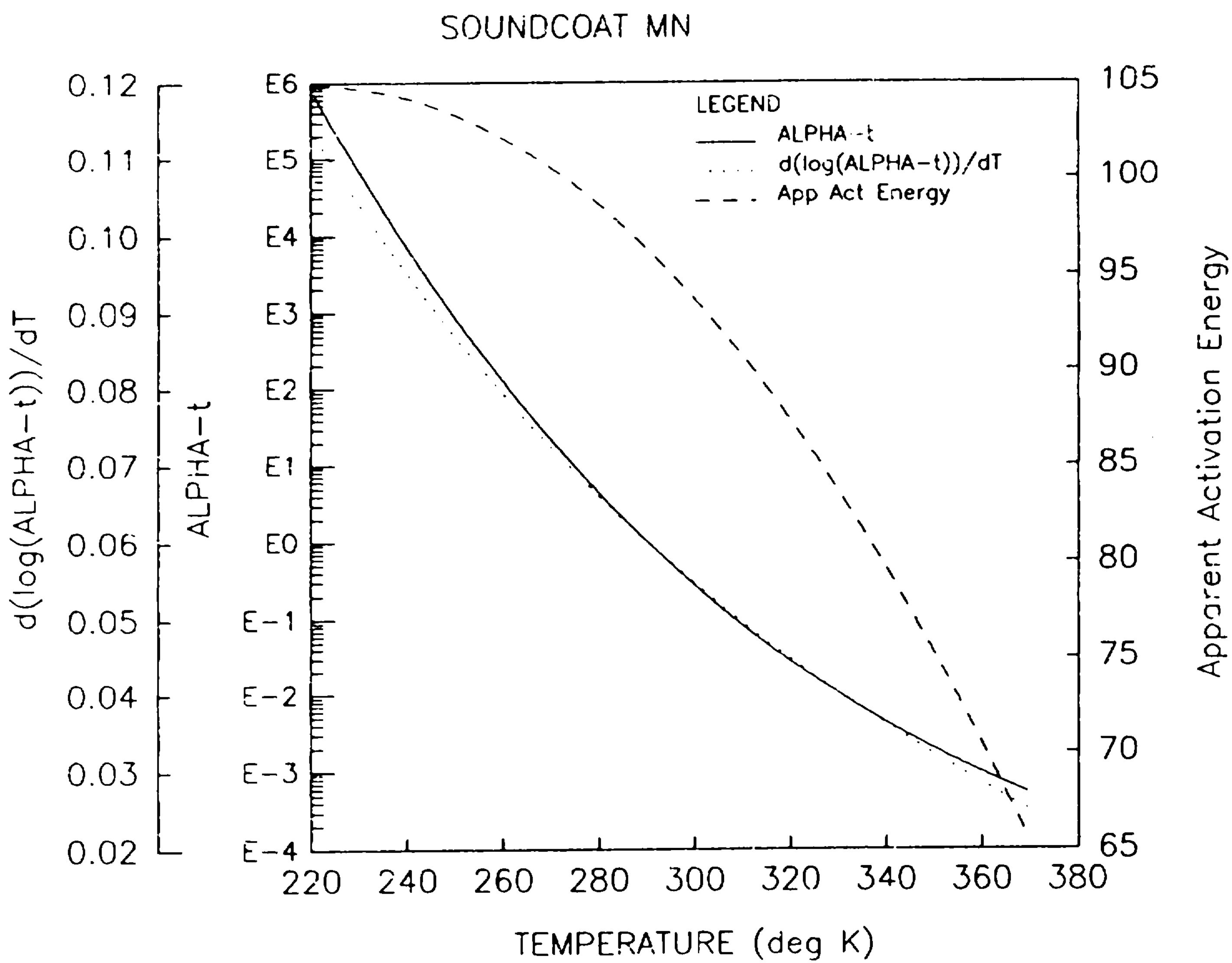

SOUNDCOAT MN
SHEAR
Temperature (deg F)
140 100 70 50 30 10 −10 −30 −50
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E2
E1
E0
E−1
E−2
E−3
FREQUENCY (Hz)
E4
E3
E2
E1
E0
E−1
REDUCED FREQUENCY (Hz)
E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9



SOUNDCOAT MN
FREQUENCY (Hz)
E4
E3
E2
220
240
260
280
300
320
340
360
380
TEMPERATURE (deg K)
-50
0
50
100
150
200
TEMPERATURE (deg F)


SOUNDCOAT MN
LOSS FACTOR
E1
E0
E−1
E−2
E−2
E−1
E0
E1
E2
E3
MAGNITUDE MODULUS (MPa)


SOUNDCOAT MN
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
220
240
260
280
300
320
340
360
380
TEMPERATURE (deg K)



SOUNDCOAT MN
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
ALPHA-t
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
Apparent Activation Energy
105
100
95
90
85
80
75
70
65
220
240
260
280
300
320
340
360
380
TEMPERATURE (deg K)

SOUNDCOAT MN SHEAR

ALFA-T MODEL

NALP	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	290.0	220.0	370.0	0.6000E-01	0.1136	0.2500E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.5000E-01	550.0	0.9000E+06	0.7000	3.000	0.2000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

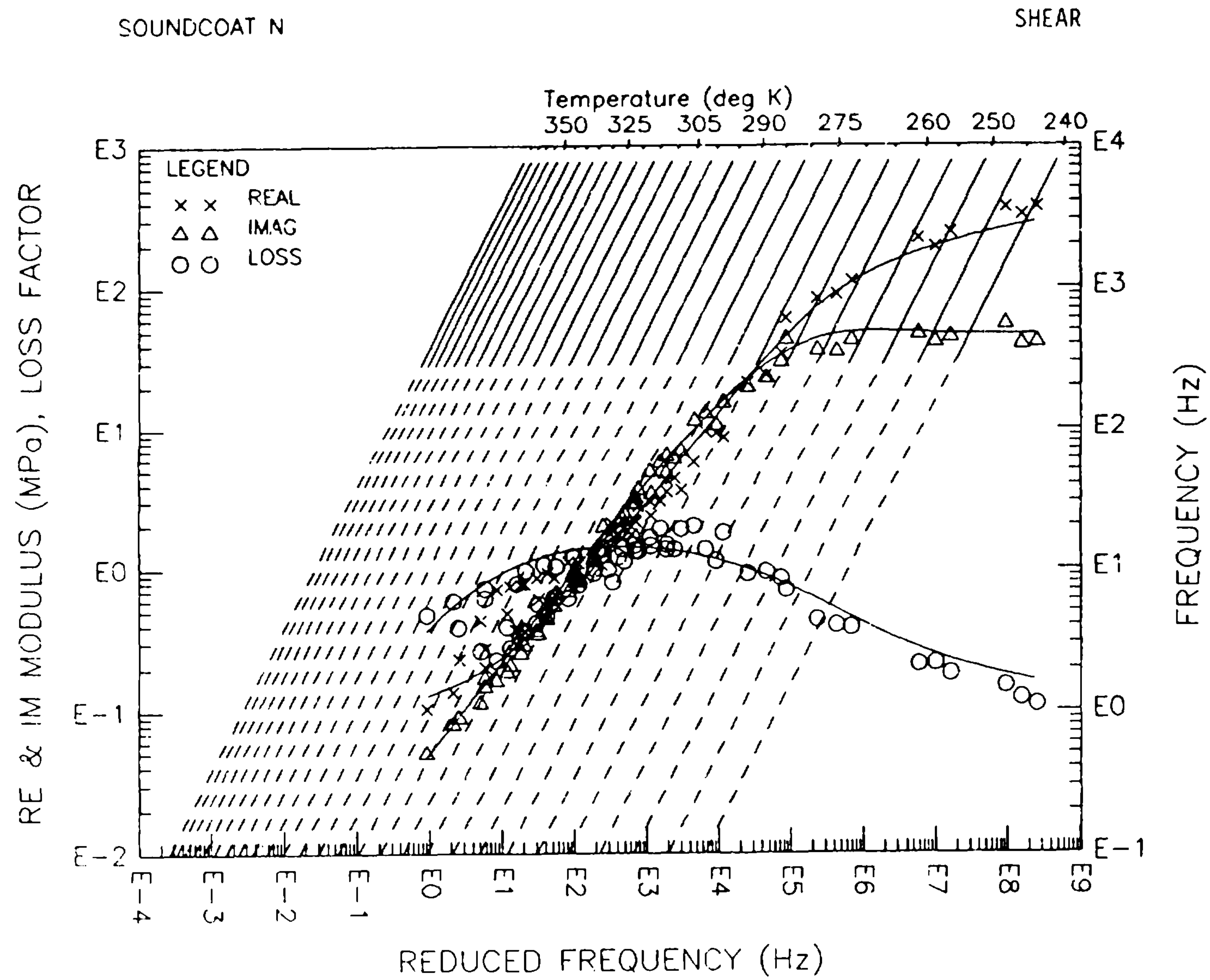
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
296.8	373.5	0.5478	1.807	0.9899
296.8	990.0	1.102	1.599	1.762
296.8	1848.	1.284	1.556	1.998
296.8	3036.	1.887	1.580	2.981
228.4	3508.	256.9	0.1023	26.28
228.4	5655.	274.4	0.9135E-01	25.07
228.4	8397.	357.0	0.7592E-01	27.10
241.9	8047.	231.9	0.1779	41.26
253.6	3210.	86.33	0.3243	28.00
253.6	5123.	105.0	0.2920	30.66
253.6	7545.	136.2	0.2925	39.84
253.6	9705.	109.1	0.3031	33.07
268.9	621.5	17.59	1.484	26.10
268.9	1665.	35.17	1.078	37.91
268.9	2777.	24.99	0.9012	22.52
268.9	4369.	32.32	0.8127	26.27
268.9	6395.	42.59	0.8145	34.69
282.6	1338.	4.433	2.961	13.13
282.6	2163.	3.861	2.981	11.51
282.6	3477.	6.892	1.892	13.04
282.6	5153.	7.764	2.938	22.81
310.5	332.2	0.1565	1.145	0.1792
310.5	913.7	0.3391	1.251	0.4242
310.5	1774.	0.5223	1.014	0.5296
310.5	4358.	0.7605	1.549	1.178
310.5	6074.	0.9350	1.573	1.471
327.4	324.7	0.9791E-01	0.9024	0.8835E-01
327.4	897.8	0.2070	0.9149	0.1894
327.4	1749.	0.3179	0.7498	0.2384
327.4	2885.	0.4546	0.7490	0.3405
327.4	4311.	0.4214	1.155	0.4867
337.0	320.9	0.7543E-01	0.7227	0.5451E-01
337.0	889.9	0.1618	0.6906	0.1117
337.0	1737.	0.2712	0.5580	0.1513
337.0	2870.	0.3934	0.5483	0.2157
337.0	4286.	0.3341	0.9217	0.3079
352.3	316.9	0.4896E-01	0.6528	0.3196E-01
352.3	881.8	0.1167	0.5346	0.6239E-01
352.3	1725.	0.2080	0.3900	0.8112E-01
352.3	2849.	0.2872	0.4301	0.1235

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
352.3	4257.	0.1803	0.9794	0.1766
364.7	314.4	0.3741E-01	0.5624	0.2104E-01
364.7	876.4	0.9694E-01	0.4085	0.3960E-01
364.7	1716.	0.1717	0.3136	0.5383E-01
364.7	2235.	0.5844E-01	0.9367	0.5474E-01
364.7	4234.	0.1146	1.239	0.1420

SOUNDCOAT N

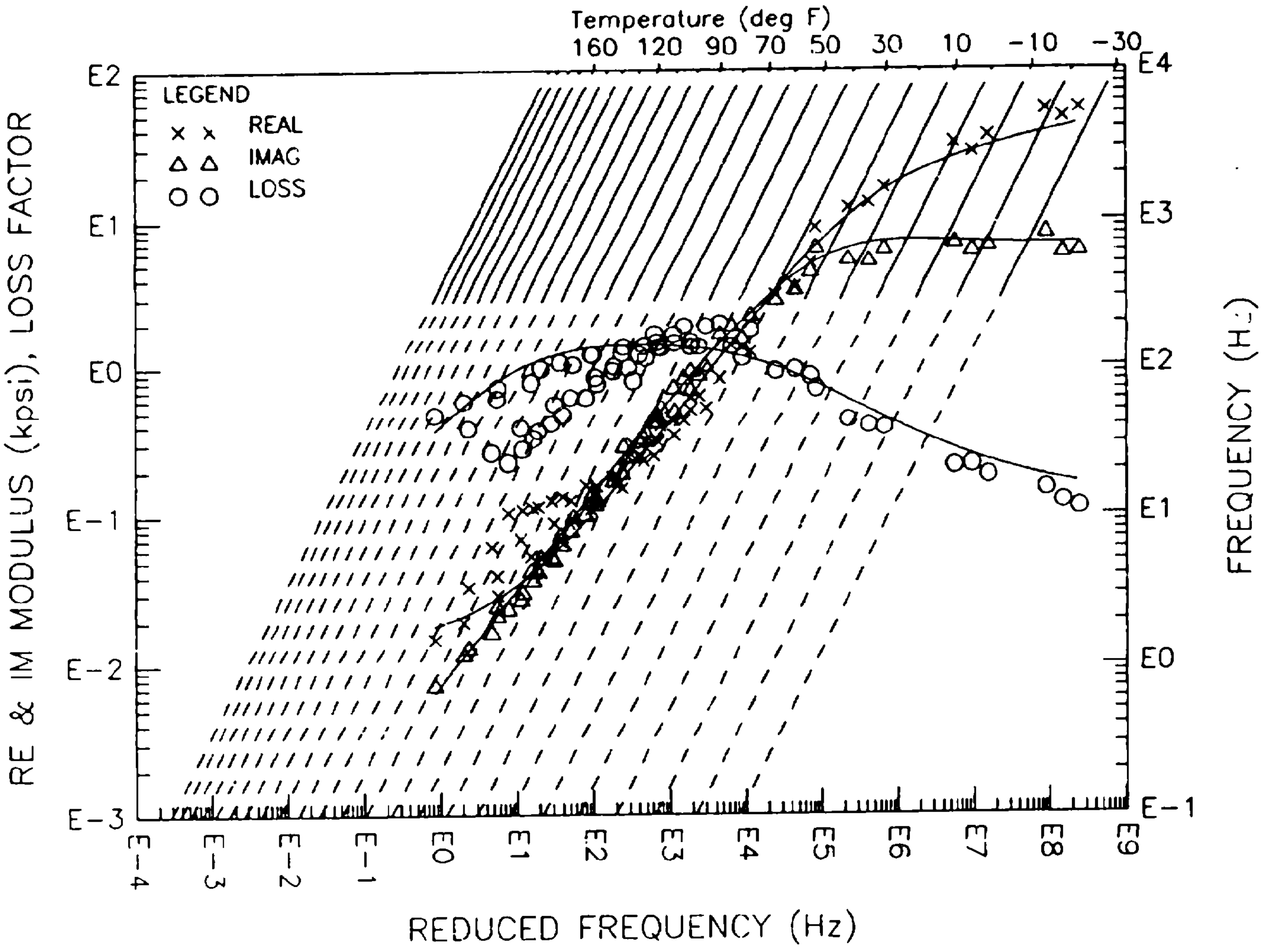
SHEAR

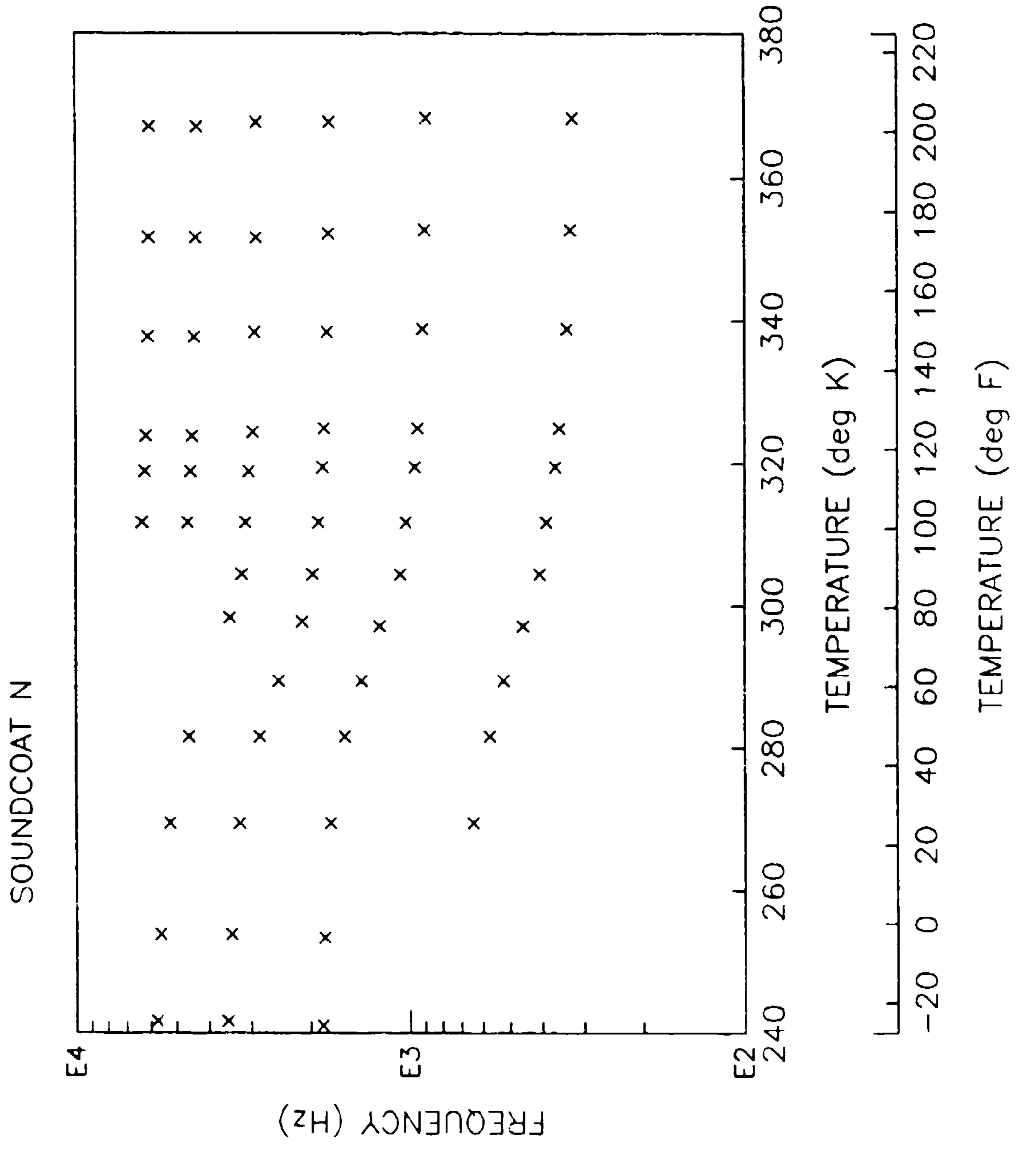
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1635	0.9938	1.420	0.9938	0.3677
MODULUS	MPA	288.8	24.10	1.655	0.2685	0.1292
	PSI	0.4189E+05	3495.	240.0	38.95	18.74
10.HZ	DEG K		254.0	276.0	298.0	
	DEG C		-39.15	-17.15	4.850	
	DEG F		-38.47	1.130	40.73	
100.HZ	DEG K		265.0	290.0	317.0	
	DEG C		-28.15	-3.150	23.85	
	DEG F		-18.67	26.33	74.93	
1000.HZ	DEG K		278.0	307.0	342.0	
	DEG C		-15.15	13.85	48.85	
	DEG F		4.730	56.93	119.9	


SOUNDCOAT N
SHEAR
Temperature (deg K)
350 325 305 290 275 260 250 240
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
E3
E2
E1
E0
E−1
E−2
E4
E3
E2
E1
E0
E−1
E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)

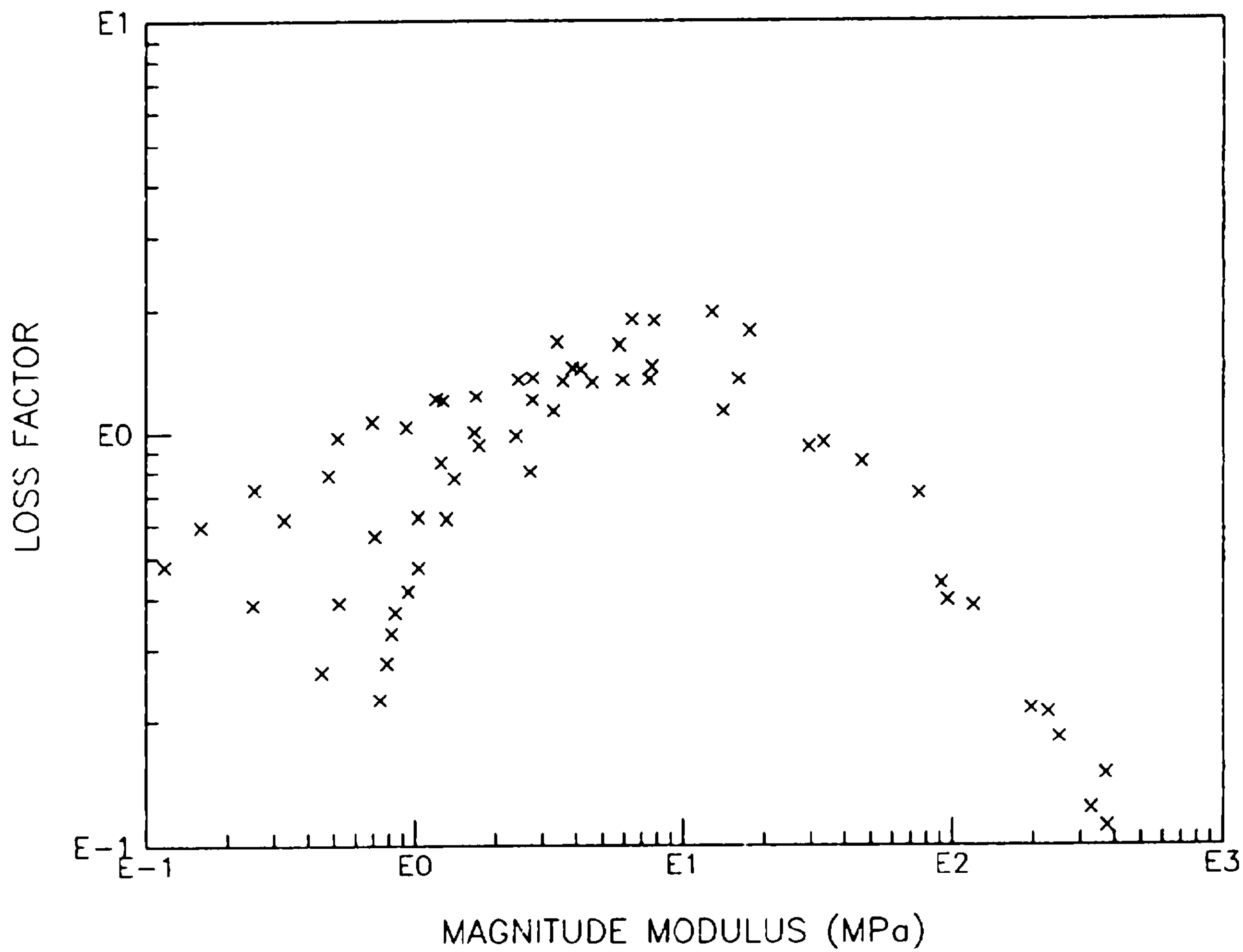
SOUNDCOAT N

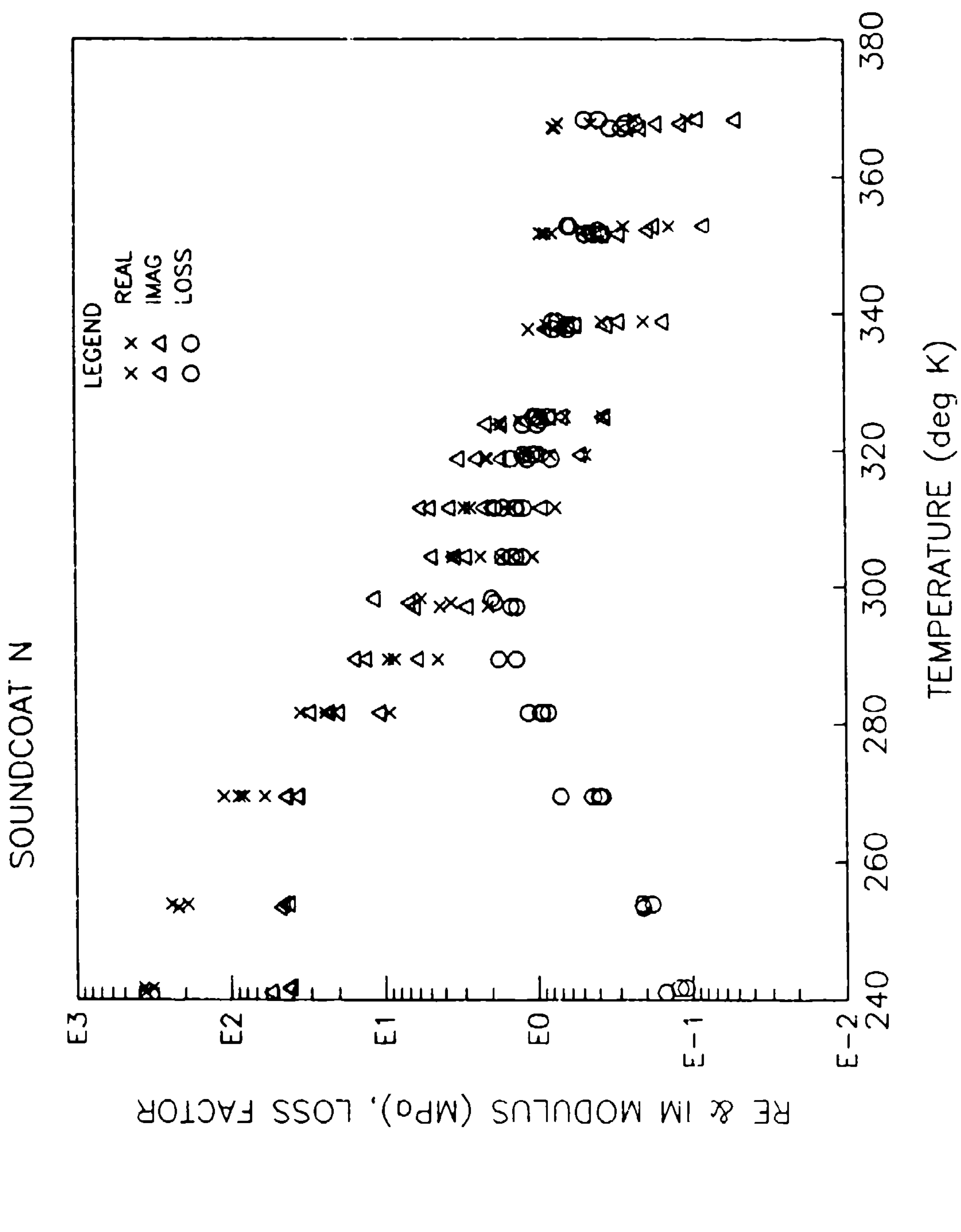
SHEAR

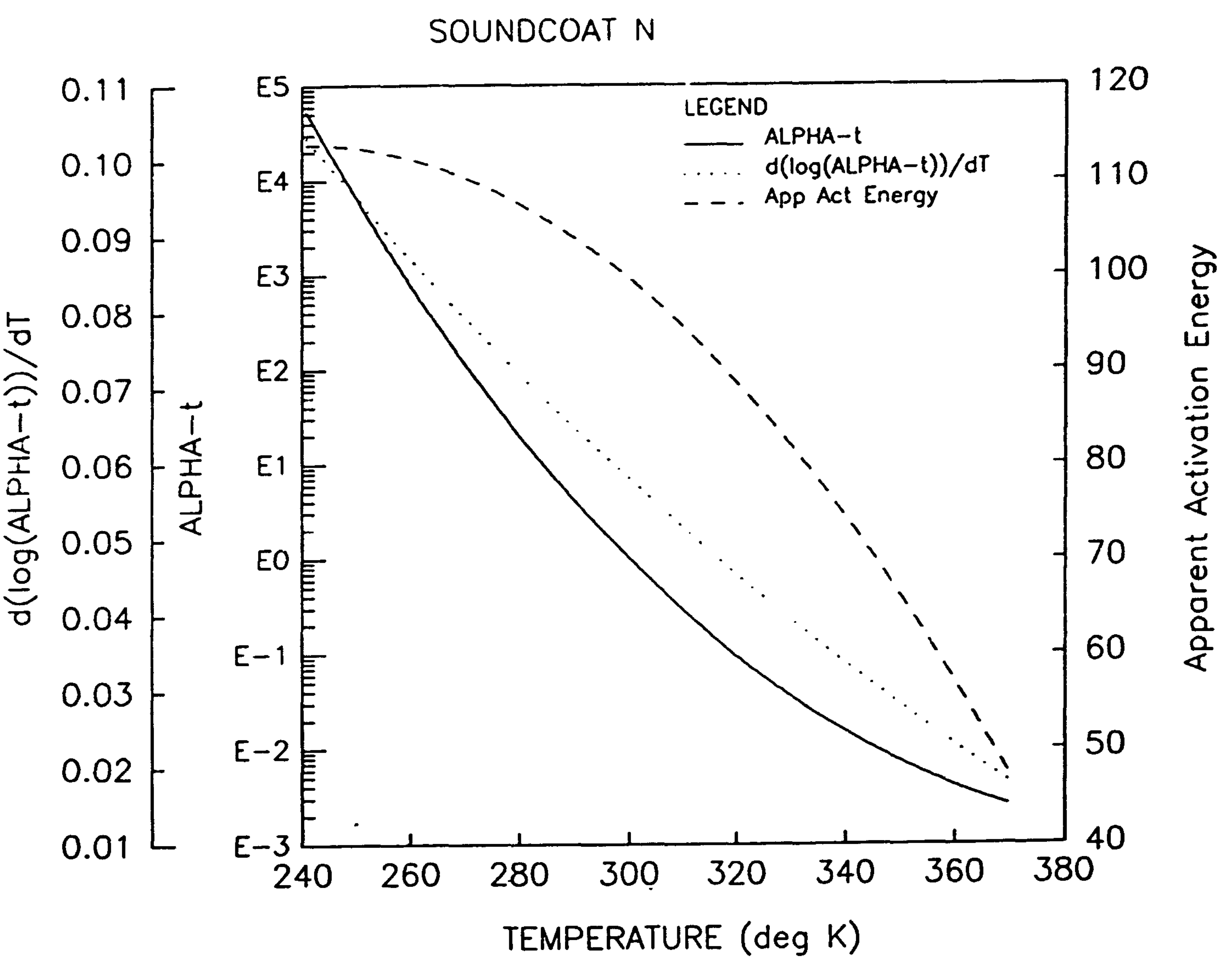



SOUNDCOAT N
FREQUENCY (Hz)
E4
E3
E2
240
260
280
300
320
340
360
380
TEMPERATURE (deg K)
-20
0
20
40
60
80
100
120
140
160
180
200
220
TEMPERATURE (deg F)

SOUNDCOAT N




SOUNDCOAT N
LEGEND
REAL
IMAG
LOSS
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR
240
260
280
300
320
340
360
380
E3
E2
E1
E0
E-1
E-2



SOUNDCOAT N
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
d(log(ALPHA-t))/dT
ALPHA-t
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
120
110
100
90
80
70
60
50
40
Apparent Activation Energy
240
260
280
300
320
340
360
380
TEMPERATURE (deg K)

SOUNDCOAT N SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	300.0	240.0	370.0	0.5800E-01	0.1036	0.1800E-01

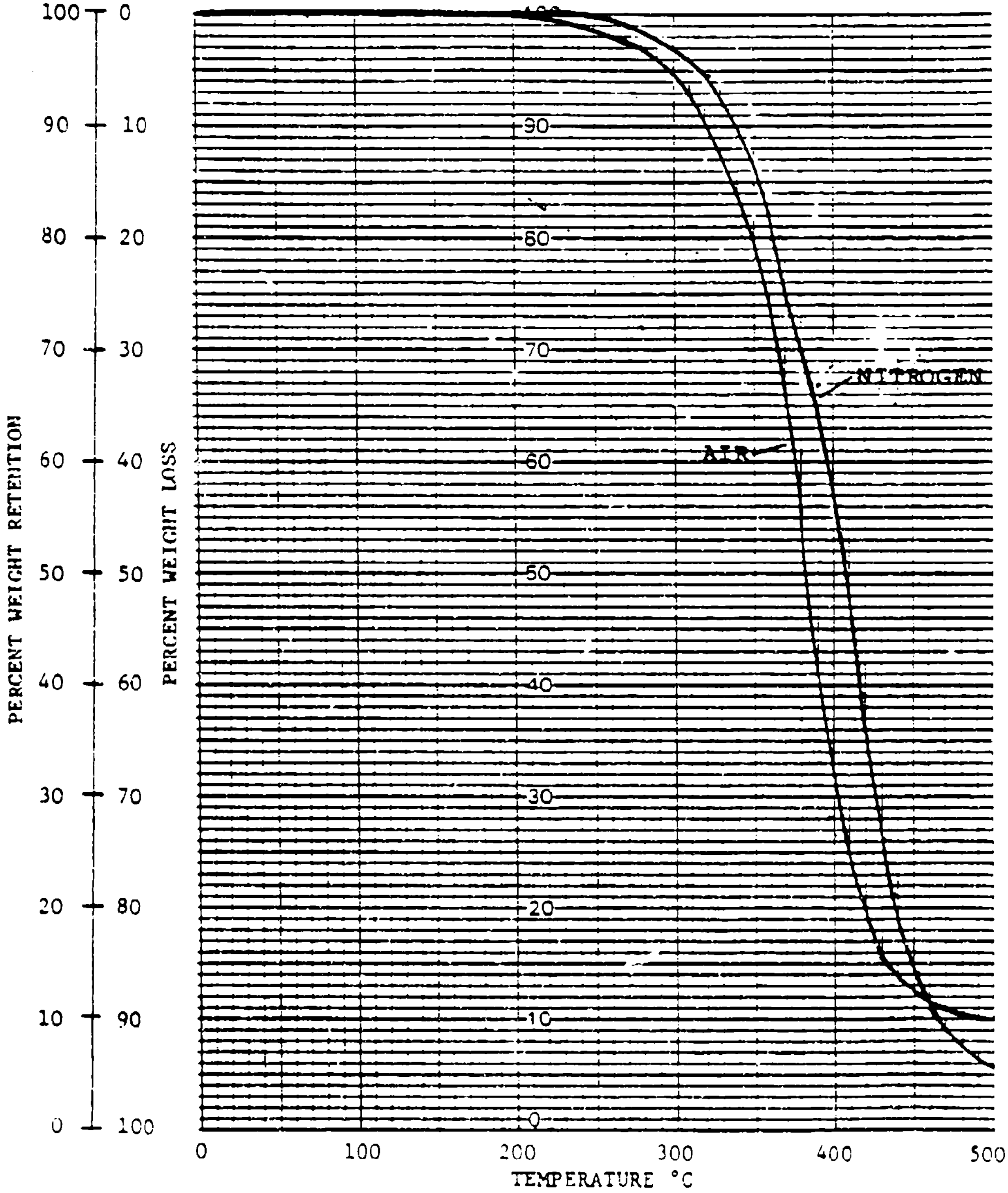
COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.1000	800.0	0.2200E+07	0.6500	3.500	0.1500

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
311.5	386.9	0.7557	1.212	0.9159
311.5	1028.	1.432	1.357	1.943
311.5	1888.	1.605	1.373	2.204
311.5	3122.	2.721	1.335	3.633
311.5	4589.	2.963	1.649	4.886
311.5	6318.	2.979	1.898	5.654
324.8	354.1	0.3658	0.9768	0.3573
324.8	945.6	0.6407	1.035	0.6631
324.8	1814.	0.9453	0.8465	0.8002
324.3	2968.	1.257	0.9334	1.173
323.7	4439.	1.689	0.9827	1.660
323.7	6160.	1.739	1.205	2.095
319.3	364.2	0.4709	1.066	0.5020
319.3	965.0	0.8102	1.204	0.9755
319.3	1836.	1.163	1.007	1.171
318.7	3046.	2.081	0.8025	1.670
318.7	4489.	2.157	1.133	2.444
318.7	6214.	2.179	1.451	3.162
297.0	456.2	2.106	1.344	2.830
297.0	1234.	4.279	1.463	6.260
297.6	2113.	3.623	1.883	6.822
298.2	3470.	5.730	1.981	11.35
281.5	572.9	9.281	1.133	10.52
281.5	1565.	21.29	0.9273	19.74
281.5	2832.	24.00	0.9509	22.82
281.5	4547.	34.85	0.8526	29.71
304.3	405.7	1.057	1.231	1.301
304.3	1068.	1.725	1.673	2.886
304.3	1963.	2.346	1.442	3.383
304.3	3200.	3.505	1.355	4.749
289.3	520.6	4.398	1.357	5.968
289.3	1394.	9.453	1.361	12.87
289.3	2477.	8.598	1.778	15.29
338.7	336.4	0.2035	0.7264	0.1478
338.7	914.4	0.3714	0.7863	0.2920
338.2	1775.	0.6138	0.5628	0.3454
338.2	2819.	0.8653	0.6253	0.5411
337.6	4367.	1.107	0.6196	0.6859
337.6	6077.	1.105	0.7713	0.8523
352.6	327.9	0.1361	0.5929	0.8069E-01

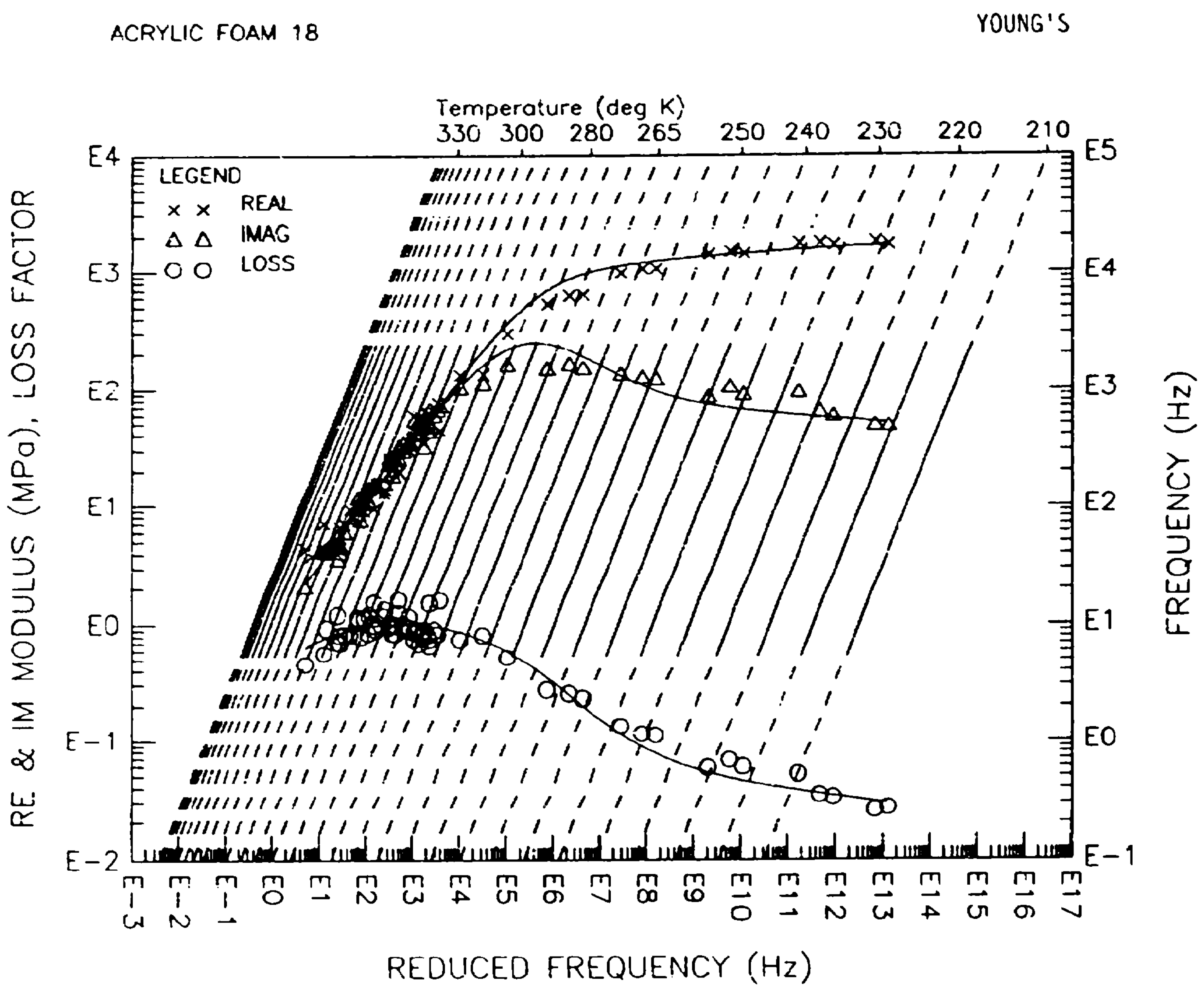
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
352.6	900.5	0.2744	0.6177	0.1695
352.0	1755.	0.4813	0.3893	0.1874
351.5	2900.	0.7847	0.3682	0.2889
351.5	4327.	0.8667	0.4160	0.3605
351.5	6034.	0.9274	0.4730	0.4387
368.2	322.9	0.1046	0.4756	0.4975E-01
368.2	892.3	0.2311	0.3850	0.8897E-01
367.6	1743.	0.4304	0.2645	0.1138
367.6	2879.	0.7157	0.2273	0.1627
367.0	4297.	0.7502	0.2777	0.2083
367.0	5997.	0.7722	0.3275	0.2529
269.3	644.0	60.77	0.7110	43.21
269.3	1738.	82.74	0.4338	35.89
269.3	3254.	88.67	0.3964	35.15
269.3	5232.	110.9	0.3833	42.51
253.2	1814.	220.0	0.2117	46.57
253.7	3441.	191.0	0.2161	41.28
253.7	5599.	243.3	0.1827	44.45
240.9	1842.	364.2	0.1499	54.59
241.5	3533.	322.8	0.1230	39.70
241.5	5751.	369.9	0.1110	41.06

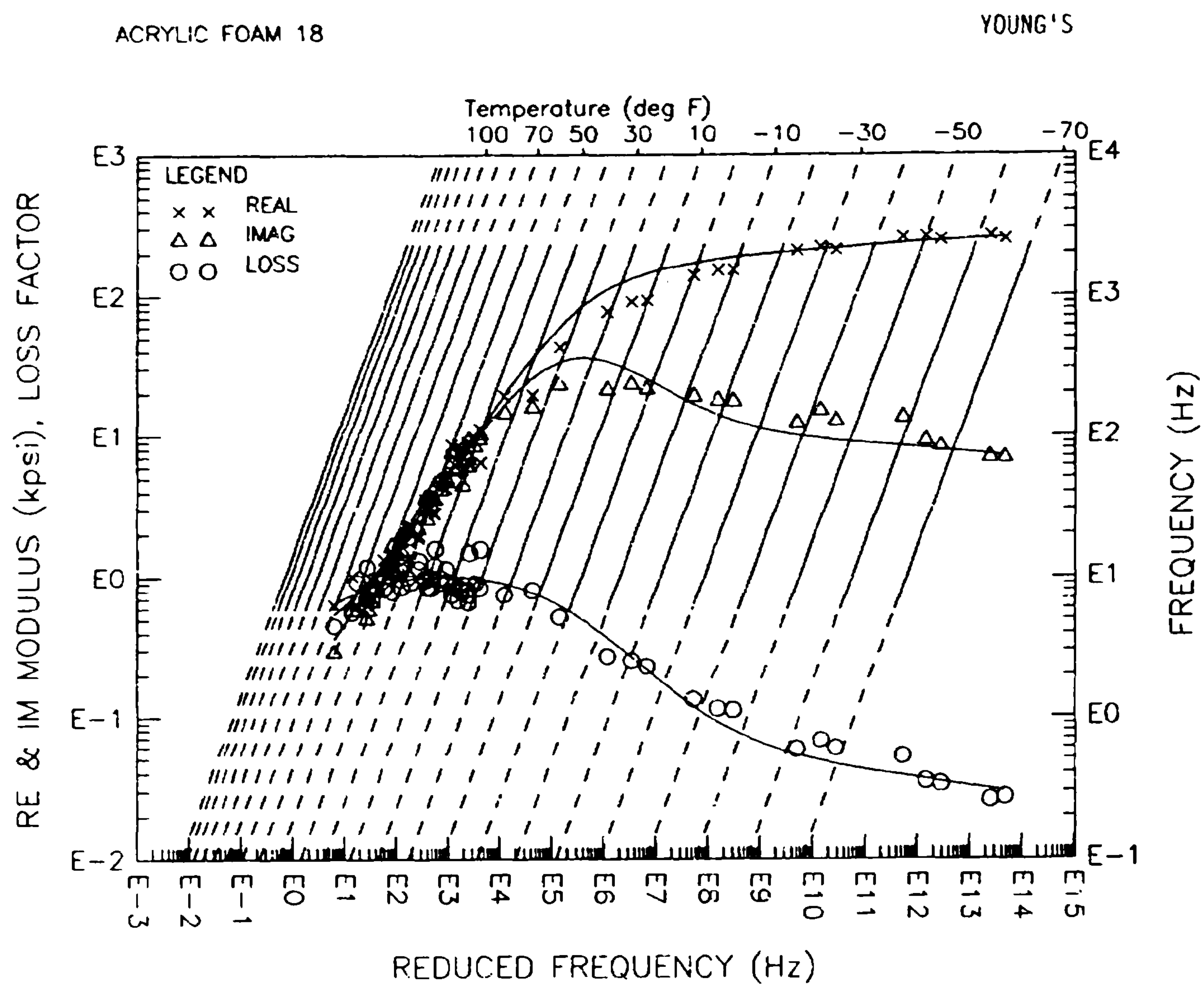


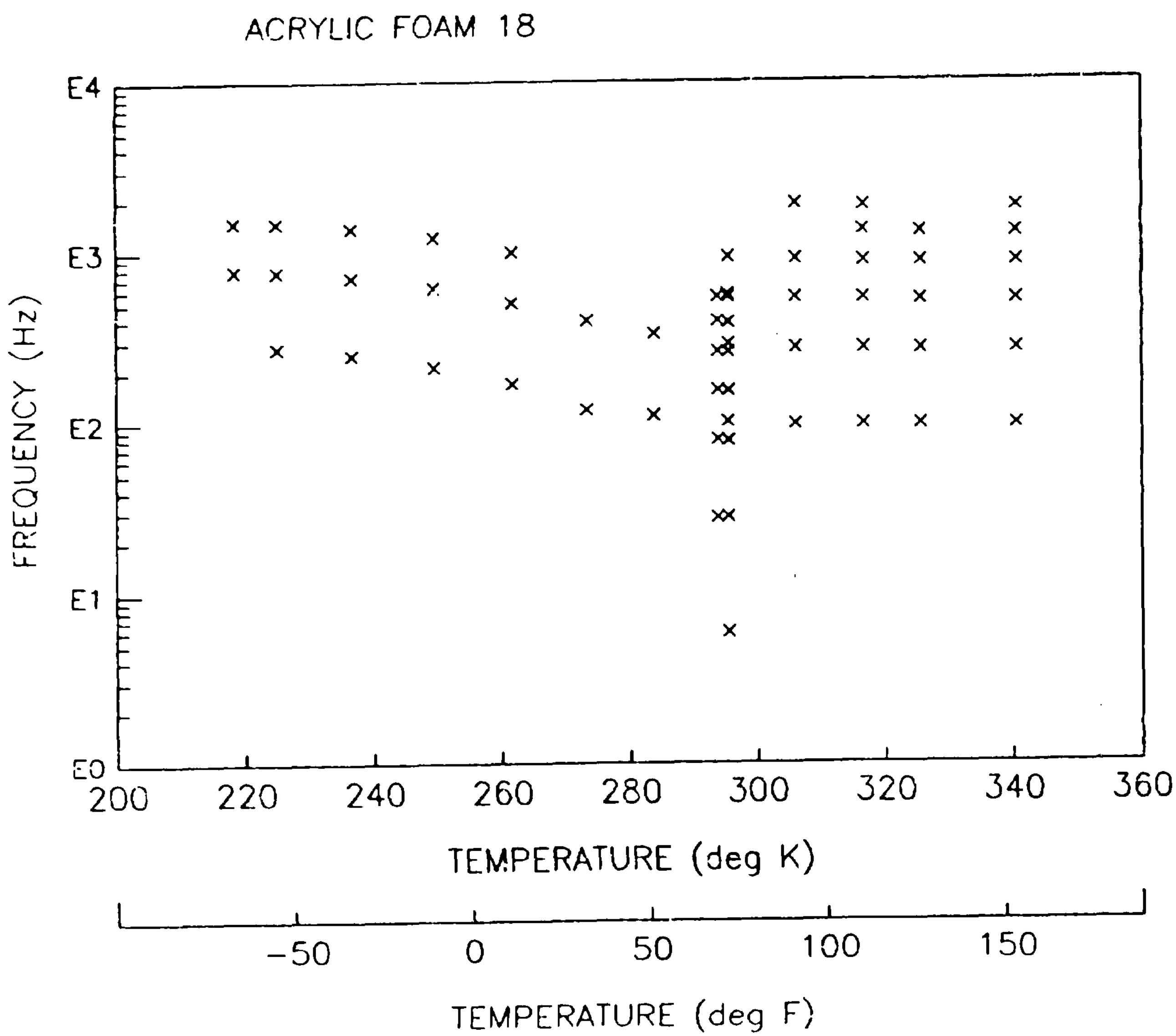
PERCENT WEIGHT RETENTION
PERCENT WEIGHT LOSS
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
NITROGEN
AIR
0
100
200
300
400
500
TEMPERATURE °C

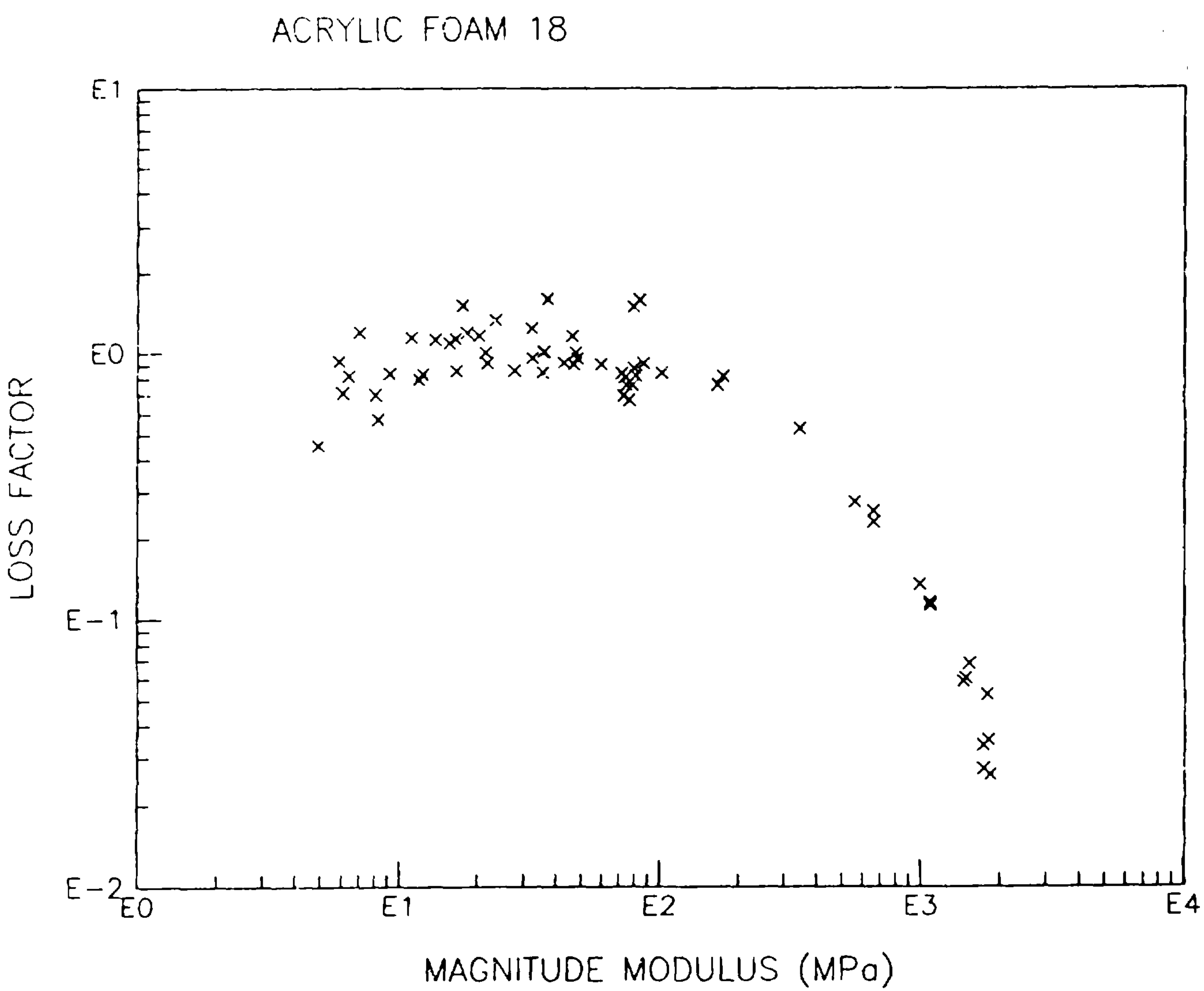
ACRYLIC FOAM 18 YOUNG'S

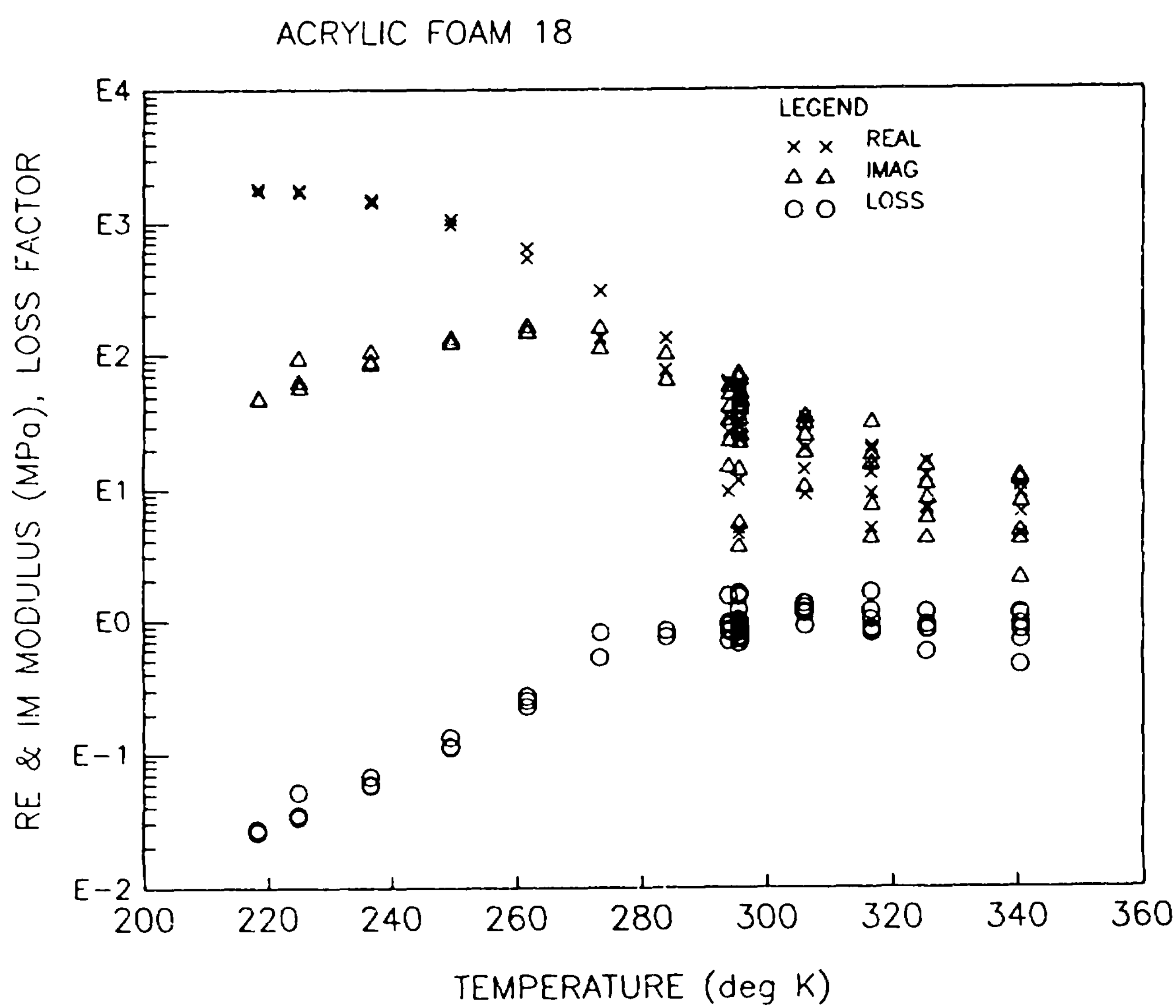
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.2973E-01	0.7077	1.011	0.7077	0.6445
MODULUS	MPA	1723.	264.9	25.59	4.059	3.467
	PSI	0.2499E+06	0.3841E+05	3755.	588.6	502.8
10.HZ	DEG K		251.0	281.0	307.0	
	DEG C		-32.15	-12.15	13.85	
	DEG F		-25.87	10.13	56.93	
100.HZ	DEG K		270.0	294.0	332.0	
	DEG C		-23.15	0.8500	38.85	
	DEG F		-9.670	33.53	101.9	
1000.HZ	DEG K		281.0	311.0	350.0	
	DEG C		-12.15	17.85	56.85	
	DEG F		10.13	64.13	134.3	


ACRYLIC FOAM 18
YOUNG'S
Temperature (deg K)
330 300 280 265 250 240 230 220 210
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)
E4 E3 E2 E1 E0 E−1 E−2
E5 E4 E3 E2 E1 E0 E−1
E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17


ACRYLIC FOAM 18
YOUNG'S
Temperature (deg F)
100 70 50 30 10 −10 −30 −50 −70
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
FREQUENCY (Hz)
E4
E3
E2
E1
E0
E−1
REDUCED FREQUENCY (Hz)
E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15

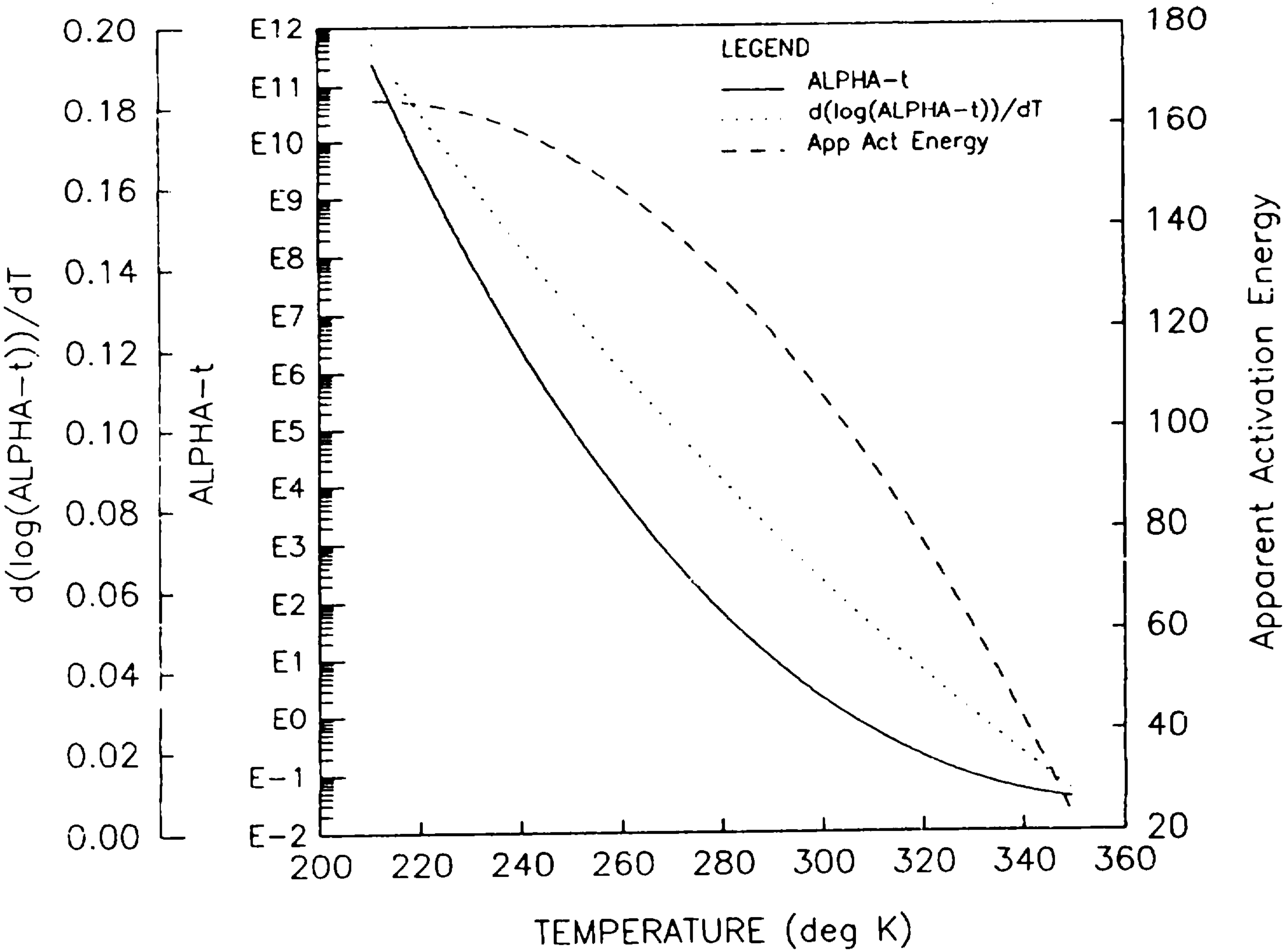

ACRYLIC FOAM 18
FREQUENCY (Hz)
E0
E1
E2
E3
E4
200
220
240
260
280
300
320
340
360
TEMPERATURE (deg K)
-50
0
50
100
150
TEMPERATURE (deg F)


ACRYLIC FOAM 18
LOSS FACTOR
E1
E0
E−1
E−2
E0
E1
E2
E3
E4
MAGNITUDE MODULUS (MPa)



ACRYLIC FOAM 18
LEGEND
REAL
IMAG
LOSS
E4
E3
E2
E1
E0
E−1
E−2
200
220
240
260
280
300
320
340
360
RE & IM MODULUS (MPa), LOSS FACTOR
TEMPERATURE (deg K)

ACRYLIC FOAM 18



ACRYLIC FOAM 18 YOUNG'S

ALFA-T MODEL							
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	305.0	210.0	350.0	0.5600E-01	0.1969	0.9300E-02

COMPLEX MODULUS MODEL							
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	1.505	2300.	0.9800E+06	0.5435	1.150	0.7500E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
340.4	95.91	4.398	0.4551	2.002
340.4	267.2	4.264	0.9318	3.973
340.4	522.9	6.567	0.6991	4.591
340.4	863.1	9.346	0.8312	7.768
340.4	1273.	10.44	1.093	11.41
340.4	1791.	10.76	1.134	12.20
325.4	96.68	7.092	0.5700	4.042
325.4	269.4	6.990	0.8344	5.832
325.4	525.0	7.254	1.147	8.320
325.4	870.8	12.47	0.8546	10.66
325.4	1291.	15.90	0.9157	14.56
316.5	96.41	4.924	0.8163	4.019
316.5	271.0	9.241	0.7943	7.340
316.5	533.9	14.99	1.004	15.05
316.5	873.1	13.04	1.165	15.19
316.5	1305.	20.73	0.8571	17.77
316.5	1830.	19.40	1.604	31.12
305.9	97.39	9.077	1.123	10.19
305.9	274.0	13.92	1.334	18.57
305.9	540.1	20.01	1.239	24.79
305.9	903.5	29.88	1.157	34.57
305.9	1886.	34.23	0.9033	30.92
295.4	100.6	25.07	1.010	25.32
295.4	289.8	43.67	0.9056	39.55
295.4	564.7	43.51	1.499	65.22
295.4	929.0	44.29	1.586	70.24
283.7	110.1	77.00	0.8375	64.49
283.7	331.8	132.4	0.7537	99.79
273.2	119.6	134.3	0.8134	109.2
273.2	398.7	299.5	0.5246	157.1
261.5	171.5	534.0	0.2730	145.8
261.5	505.5	630.2	0.2537	159.9
261.5	993.7	637.8	0.2305	147.0
249.3	214.7	976.0	0.1340	130.8
249.3	617.9	1063.	0.1153	122.6
249.3	1213.	1068.	0.1123	119.9
236.5	252.1	1438.	0.5860E-01	84.27
236.5	716.9	1516.	0.6790E-01	102.9
236.5	1386.	1470.	0.5980E-01	87.91
224.8	276.0	1772.	0.5210E-01	92.32

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
224.8	770.5	1788.	0.3500E-01	62.58
224.8	1481.	1713.	0.3340E-01	57.21
218.2	778.5	1830.	0.2590E-01	47.40
218.2	1487.	1726.	0.2720E-01	46.95
295.4	5.930	4.915	0.7108	3.494
295.4	77.74	23.19	0.9551	22.15
295.4	154.3	31.35	0.9167	28.74
295.4	260.3	59.28	0.7538	44.69
295.4	385.0	54.31	0.8374	45.48
295.4	545.2	62.26	0.7539	46.94
295.4	5.920	4.458	1.201	5.354
295.4	28.08	11.53	1.197	13.80
295.4	78.20	25.02	1.006	25.17
295.4	155.2	33.34	1.003	33.44
295.4	260.4	59.48	0.8725	51.90
295.4	387.4	56.64	0.8057	45.63
295.4	546.4	63.13	0.6655	42.01
293.7	27.88	9.512	1.516	14.42
293.7	78.64	26.78	0.8437	22.59
293.7	155.8	34.61	0.9503	32.89
293.7	260.2	59.19	0.6929	41.01
293.7	392.6	61.73	0.8184	50.52
293.7	546.8	63.42	0.9105	57.74

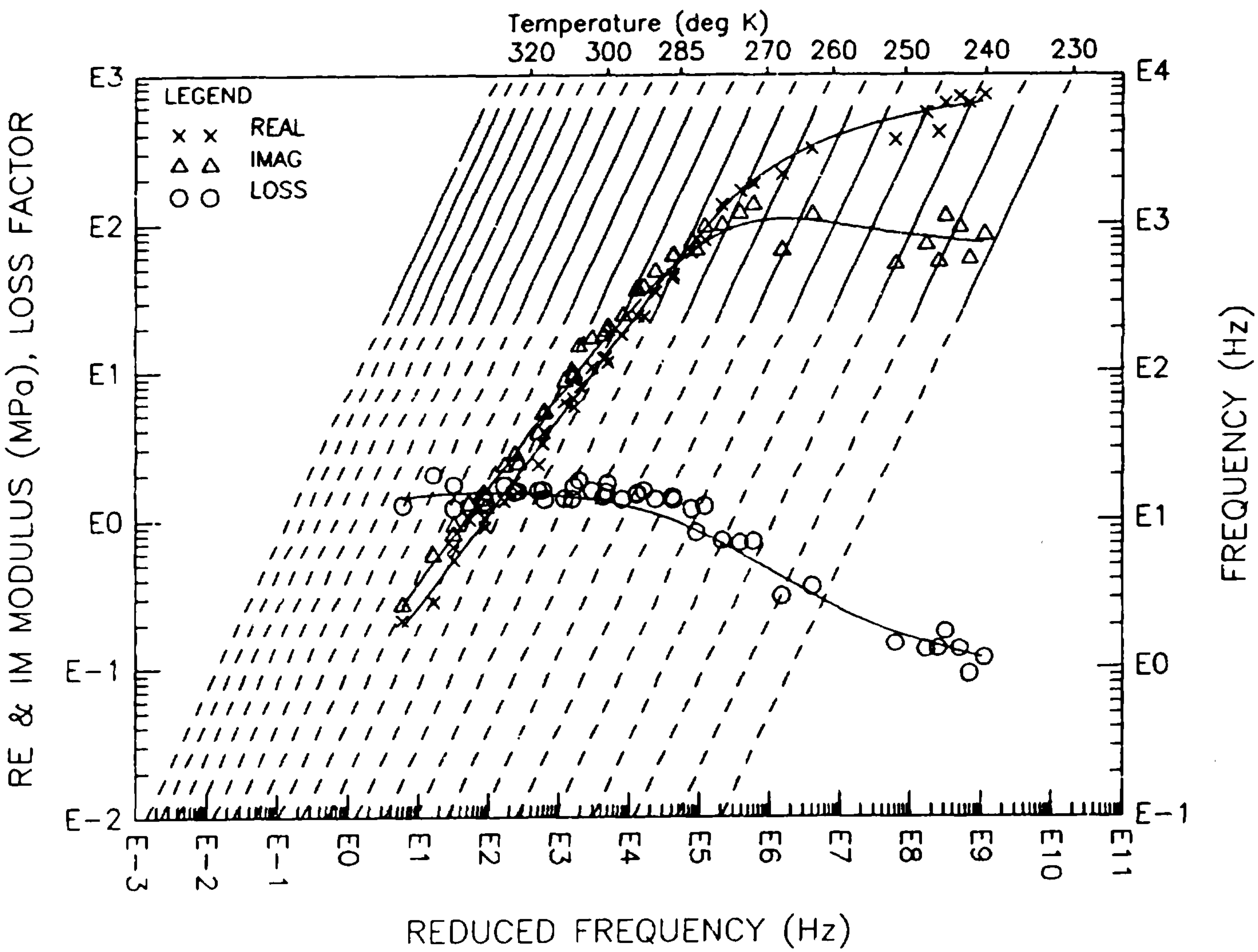
UDRI II

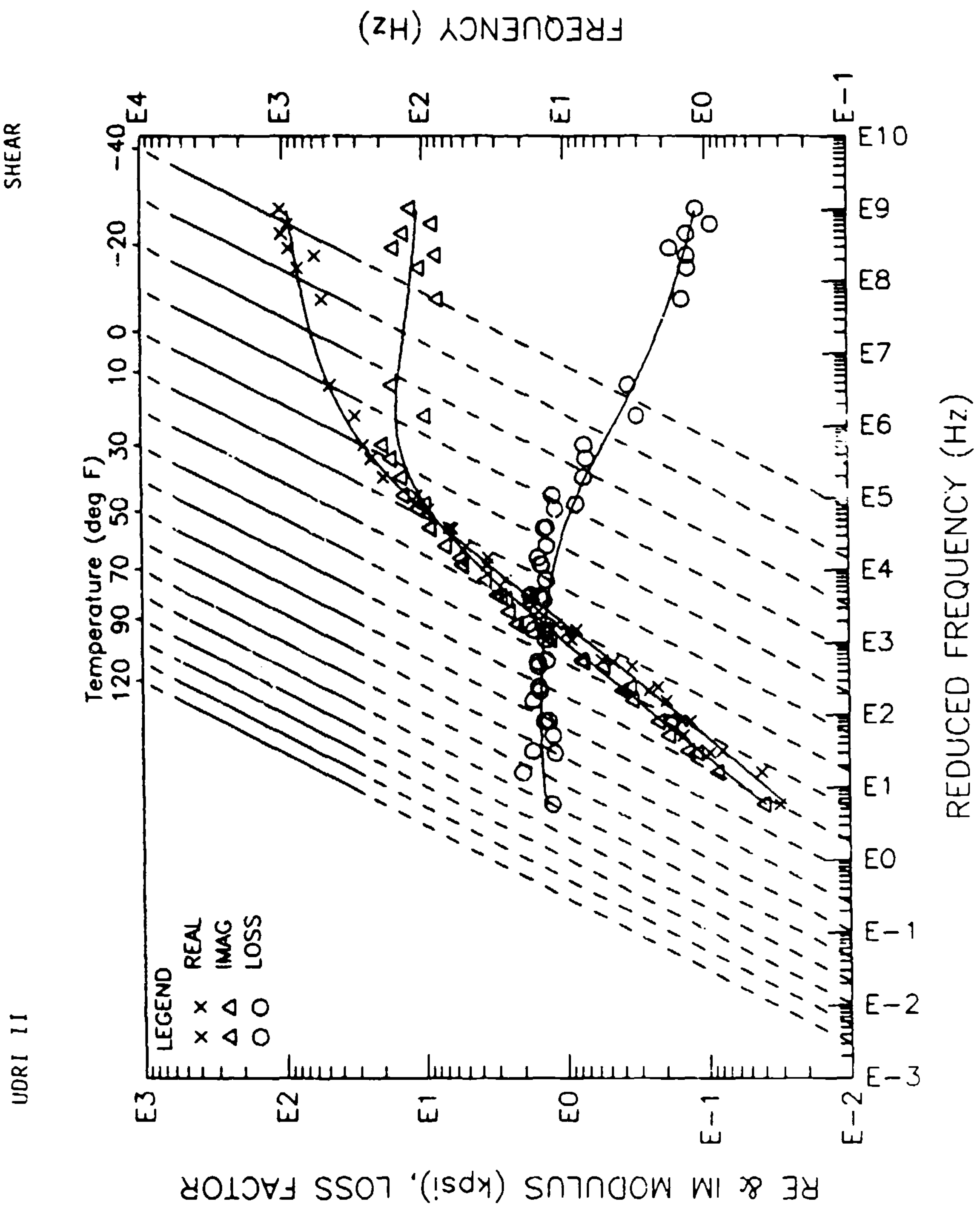
SHEAR

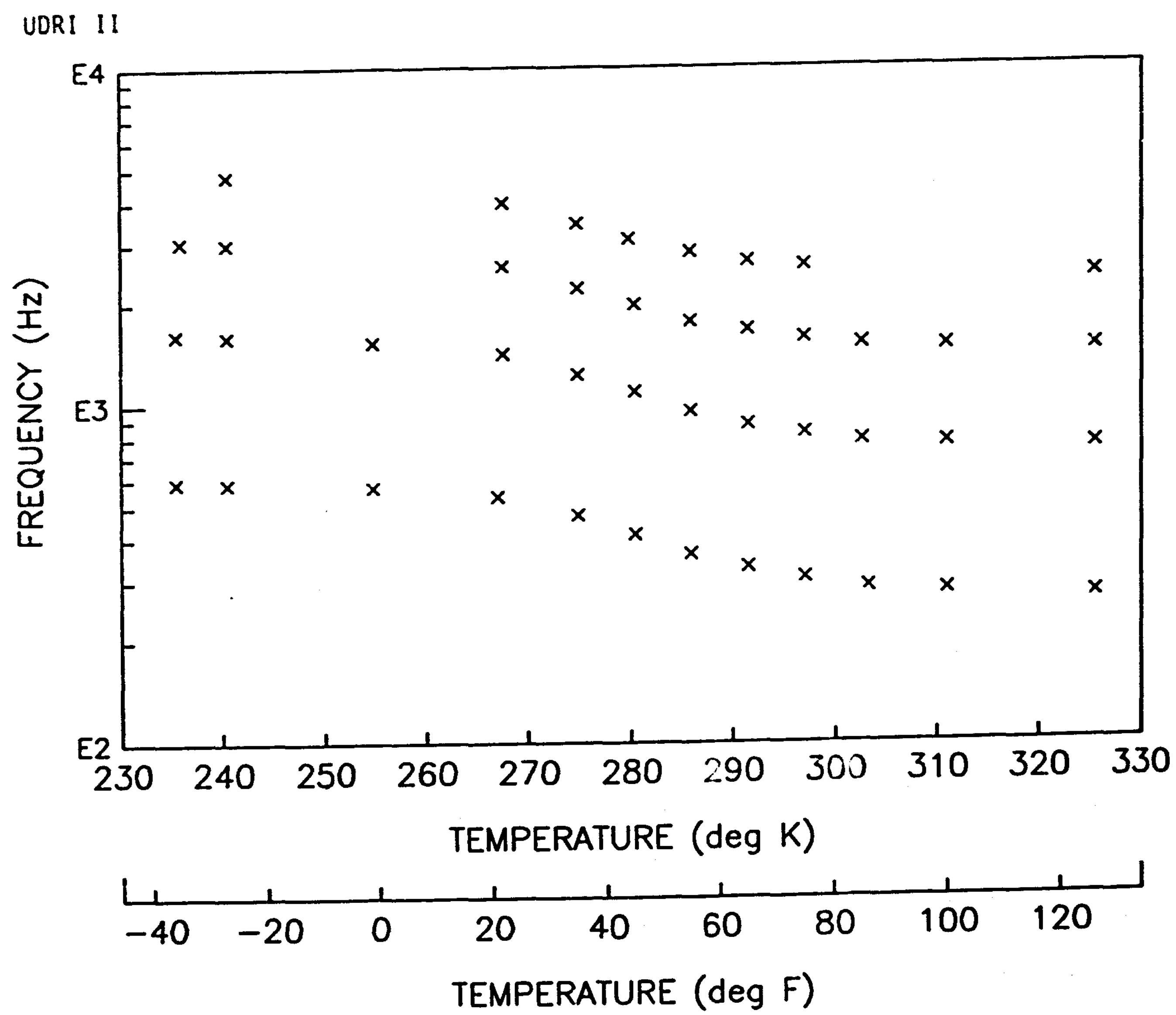
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1156	1.055	1.507	1.055	1.396
MODULUS	MPA	638.6	43.63	1.019	0.6849E-01	0.1954
	PSI	0.9262E+05	6328.	147.7	9.933	28.34
10.HZ	DEG K		254.0	282.0	314.0	
	DEG C		-39.15	-11.15	20.85	
	DEG F		-38.47	11.93	69.53	
100.HZ	DEG K		264.0	296.0	330.0	
	DEG C		-29.15	2.850	36.85	
	DEG F		-20.47	37.13	98.33	
1000.HZ	DEG K		275.0	313.0	330.0	
	DEG C		-18.15	19.85	36.85	
	DEG F		-.6700	67.73	98.33	

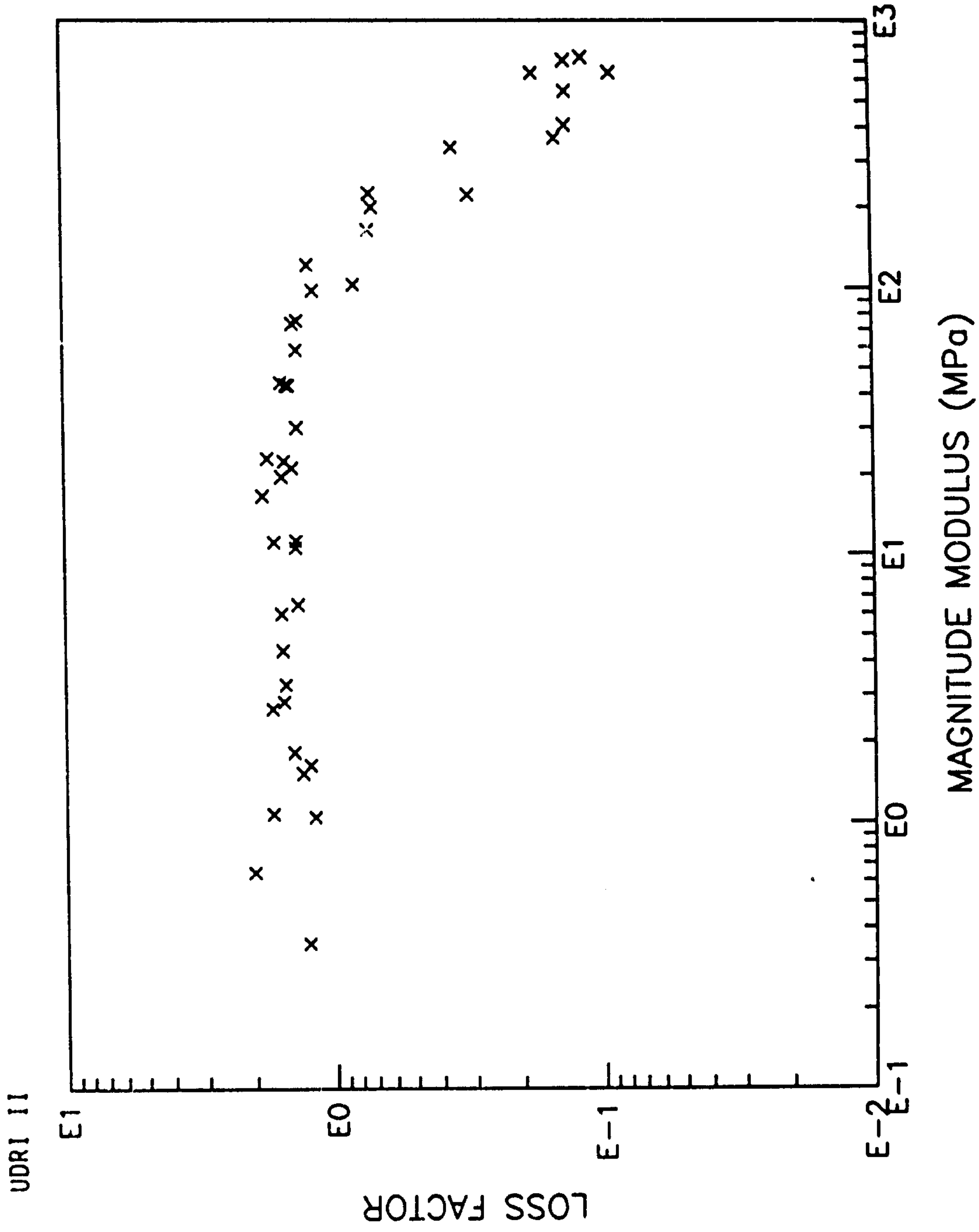
UDRI II

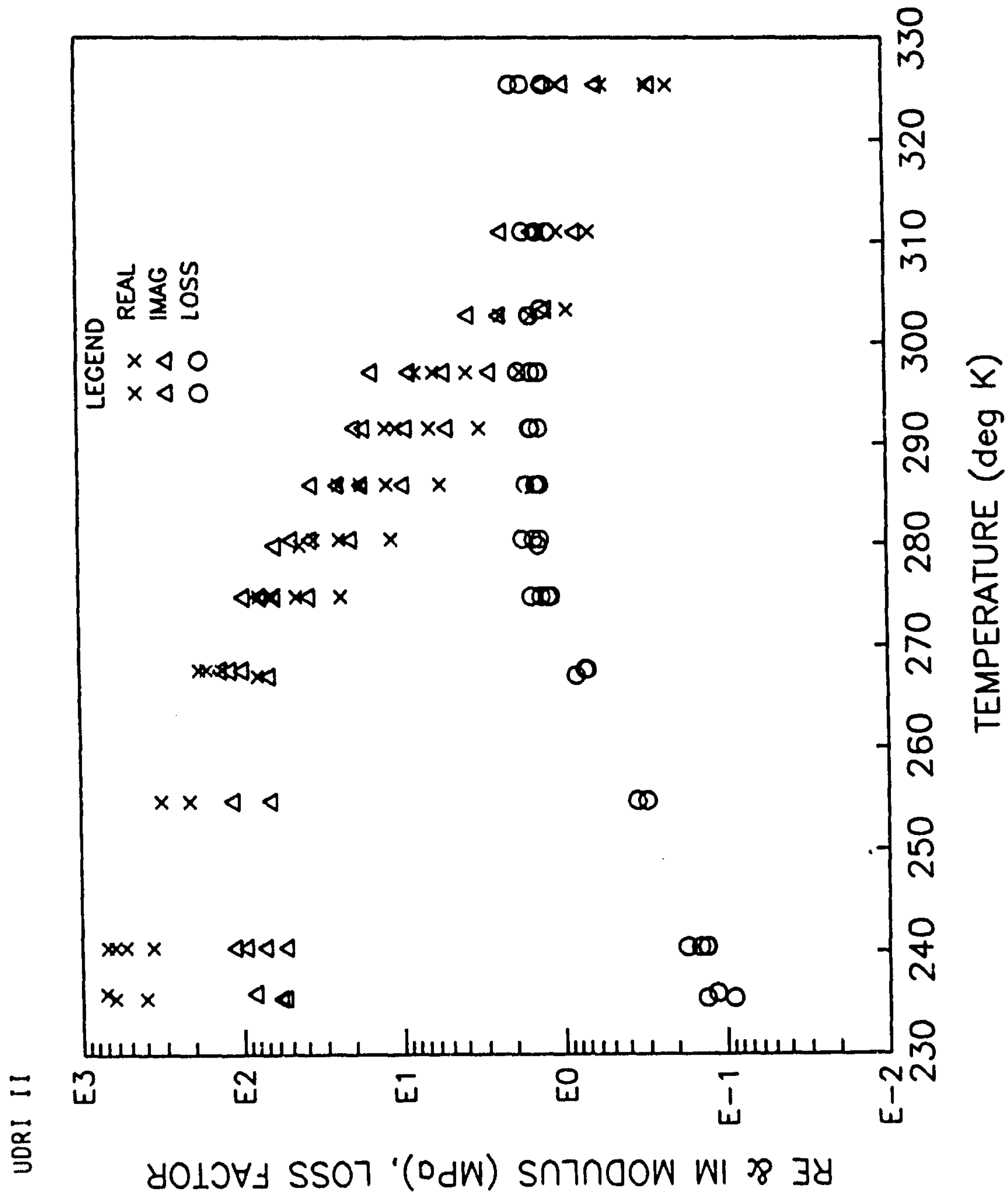
SHEAR



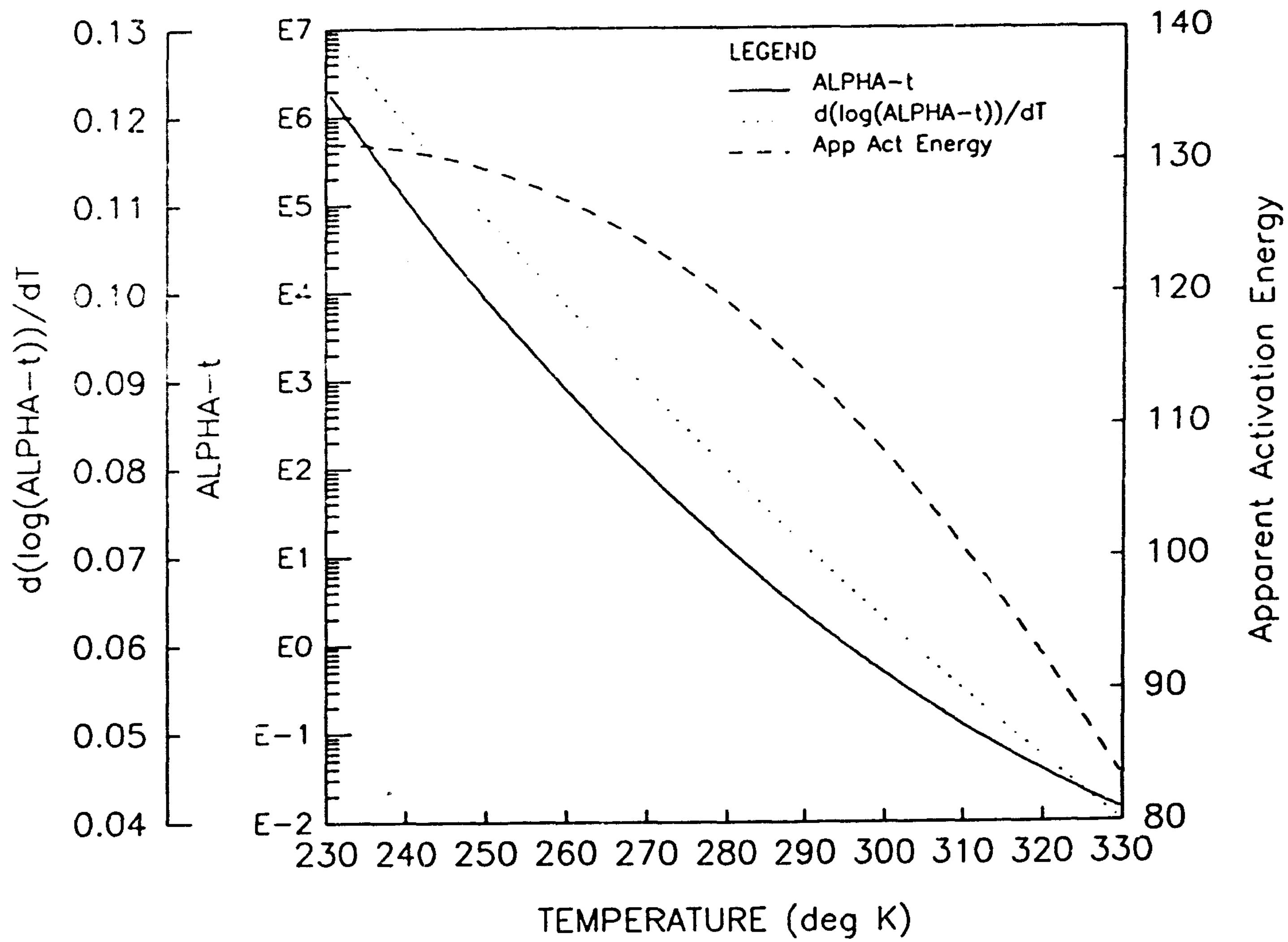

SHEAR
UDRI II
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
Temperature (deg F)
120 90 70 50 30 10 0 -20 -40
RE & IM MODULUS (kpsi), LOSS FACTOR
REDUCED FREQUENCY (Hz)
FREQUENCY (Hz)
E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10


UDRI II
FREQUENCY (Hz)
E4
E3
E2
230
240
250
260
270
280
290
300
310
320
330
TEMPERATURE (deg K)
-40
-20
0
20
40
60
80
100
120
TEMPERATURE (deg F)


UDRI II
LOSS FACTOR
E1
E0
E−1
E−2
MAGNITUDE MODULUS (MPa)
E−1
E0
E1
E2
E3


UDRI II
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
230
240
250
260
270
280
290
300
310
320
330
TEMPERATURE (deg K)

UDRI II



LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
ALPHA-t
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
Apparent Activation Energy
140
130
120
110
100
90
80
230 240 250 260 270 280 290 300 310 320 330
TEMPERATURE (deg K)

UDRI II SHEAR

ALFA-T MODEL							
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	295.0	230.0	330.0	0.6687E-01	0.1301	0.4008E-01

COMPLEX MODULUS MODEL							
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.2176E-01	1135.	0.1939E+07	0.6413	2.083	0.1576

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
297.0	305.4	1.784	1.529	2.728
297.0	818.9	3.833	1.364	5.228
297.0	1572.	6.190	1.387	8.586
297.0	2570.	7.984	1.842	14.71
235.4	589.5	402.8	0.1344	54.14
235.4	1615.	630.5	0.9100E-01	57.38
235.9	3051.	716.4	0.1158	82.96
240.4	586.3	360.7	0.1464	52.81
240.4	1597.	535.5	0.1330	71.22
240.4	3013.	622.3	0.1767	110.0
240.4	4798.	697.8	0.1340	93.51
254.8	569.2	212.0	0.3083	65.36
254.8	1535.	317.1	0.3545	112.4
267.0	534.6	79.22	0.8313	65.86
267.6	1413.	132.4	0.7321	96.93
267.6	2574.	163.1	0.7057	115.1
267.6	3974.	182.5	0.7223	131.8
274.8	470.2	23.80	1.557	37.06
274.8	1227.	44.93	1.350	60.66
274.8	2213.	63.36	1.177	74.57
274.8	3443.	77.02	1.227	94.50
280.4	411.9	11.47	1.757	20.15
280.4	1090.	24.06	1.495	35.97
280.4	1976.	34.63	1.361	47.13
279.8	3095.	42.68	1.406	60.01
285.9	360.2	5.715	1.671	9.550
285.9	953.3	12.25	1.423	17.43
285.9	1768.	17.81	1.369	24.38
285.9	2826.	24.35	1.459	35.53
291.5	328.9	3.221	1.573	5.067
291.5	867.6	6.613	1.380	9.126
291.5	1652.	10.65	1.564	16.66
291.5	2645.	12.36	1.530	18.91
303.2	286.6	0.9129	1.325	1.210
302.6	775.8	1.527	1.549	2.365
302.6	1504.	2.362	1.564	3.694
310.9	280.5	0.6667	1.200	0.8000
310.9	764.0	1.045	1.425	1.489
310.9	1462.	1.336	1.713	2.289
325.4	269.7	0.2148	1.263	0.2713

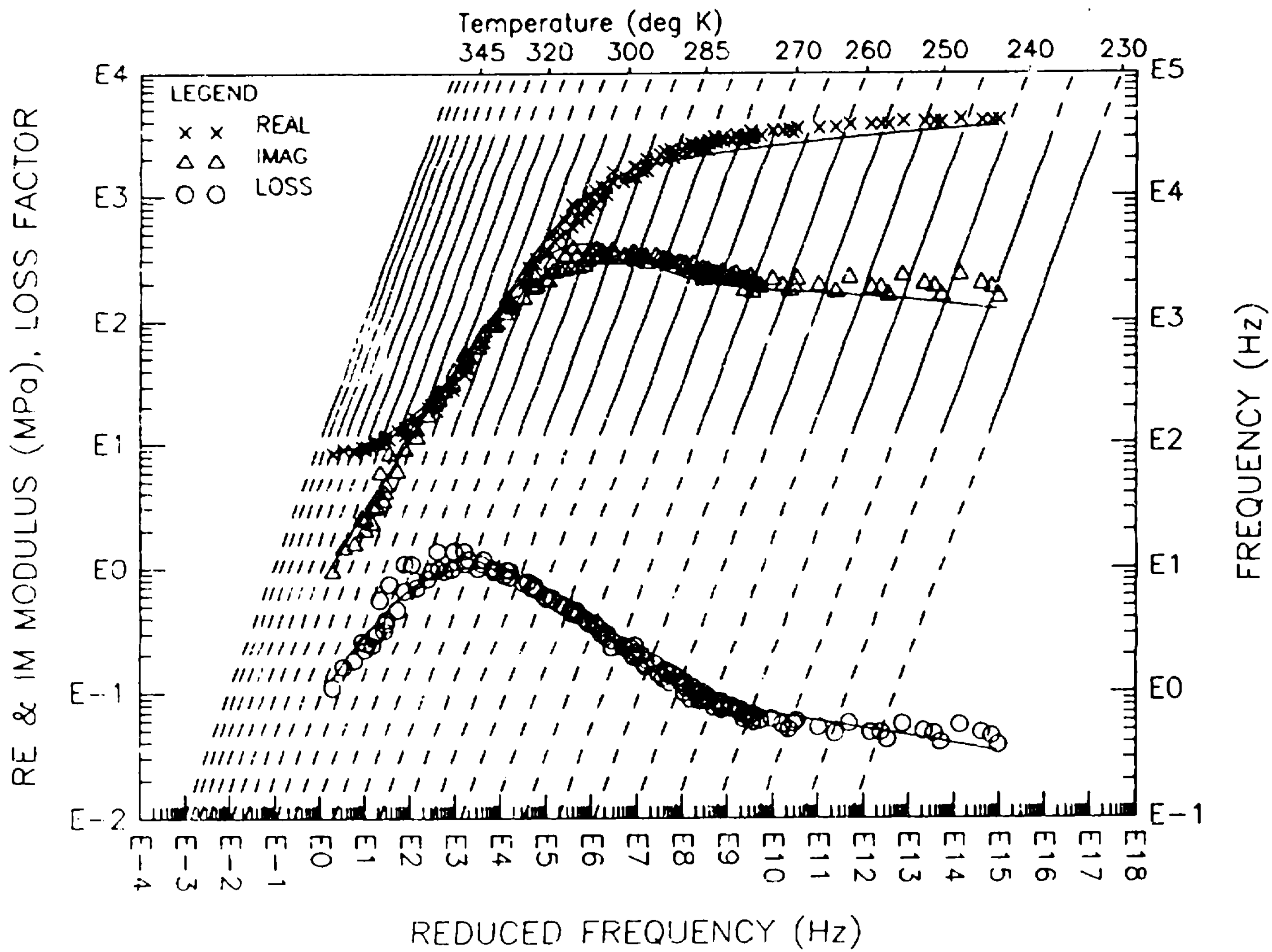
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
325.4	746.1	0.2858	2.014	0.5756
325.4	1454.	0.5389	1.716	0.9248
325.4	2400.	1.020	1.239	1.264

POLYURETHANE 24-8-1 YOUNG'S

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.3373E-01	0.7210	1.030	0.7210	0.1292
MODULUS	MPA	3693.	461.2	68.86	17.99	8.651
	PSI	0.5357E+06	0.6688E+05	9988.	2609.	1255.
10.HZ	DEG K		281.0	294.0	307.0	
	DEG C		-12.15	0.8500	13.85	
	DEG F		10.13	33.53	56.93	
100.HZ	DEG K		289.0	303.0	318.0	
	DEG C		-4.150	9.850	24.85	
	DEG F		24.53	49.73	76.73	
1000.HZ	DEG K		298.0	314.0	333.0	
	DEG C		4.850	20.85	39.85	
	DEG F		40.73	69.53	103.7	

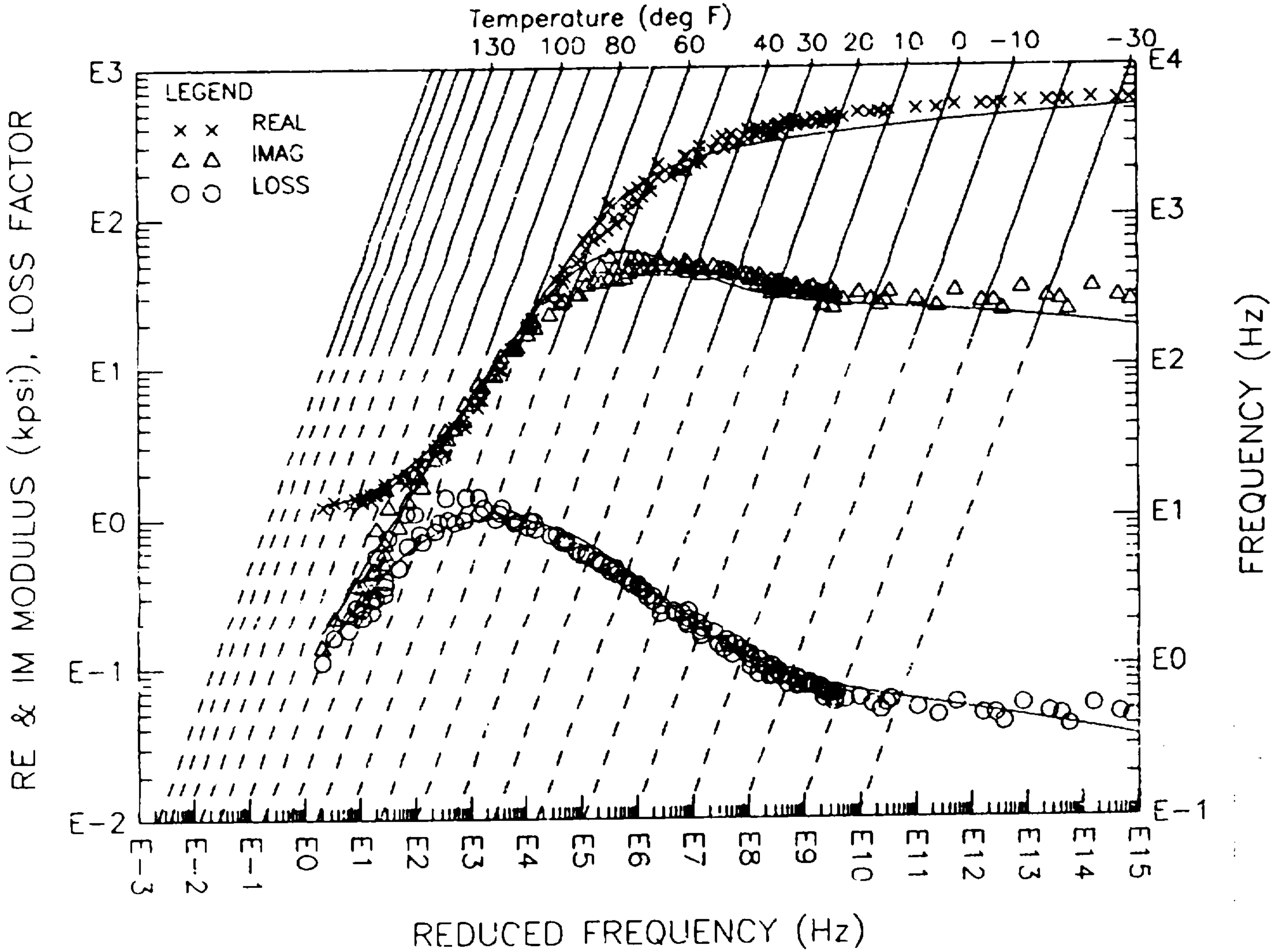
POLYURETHANE 24-8-1

YOUNG'S



POLYURETHANE 24-8-1

YOUNG'S



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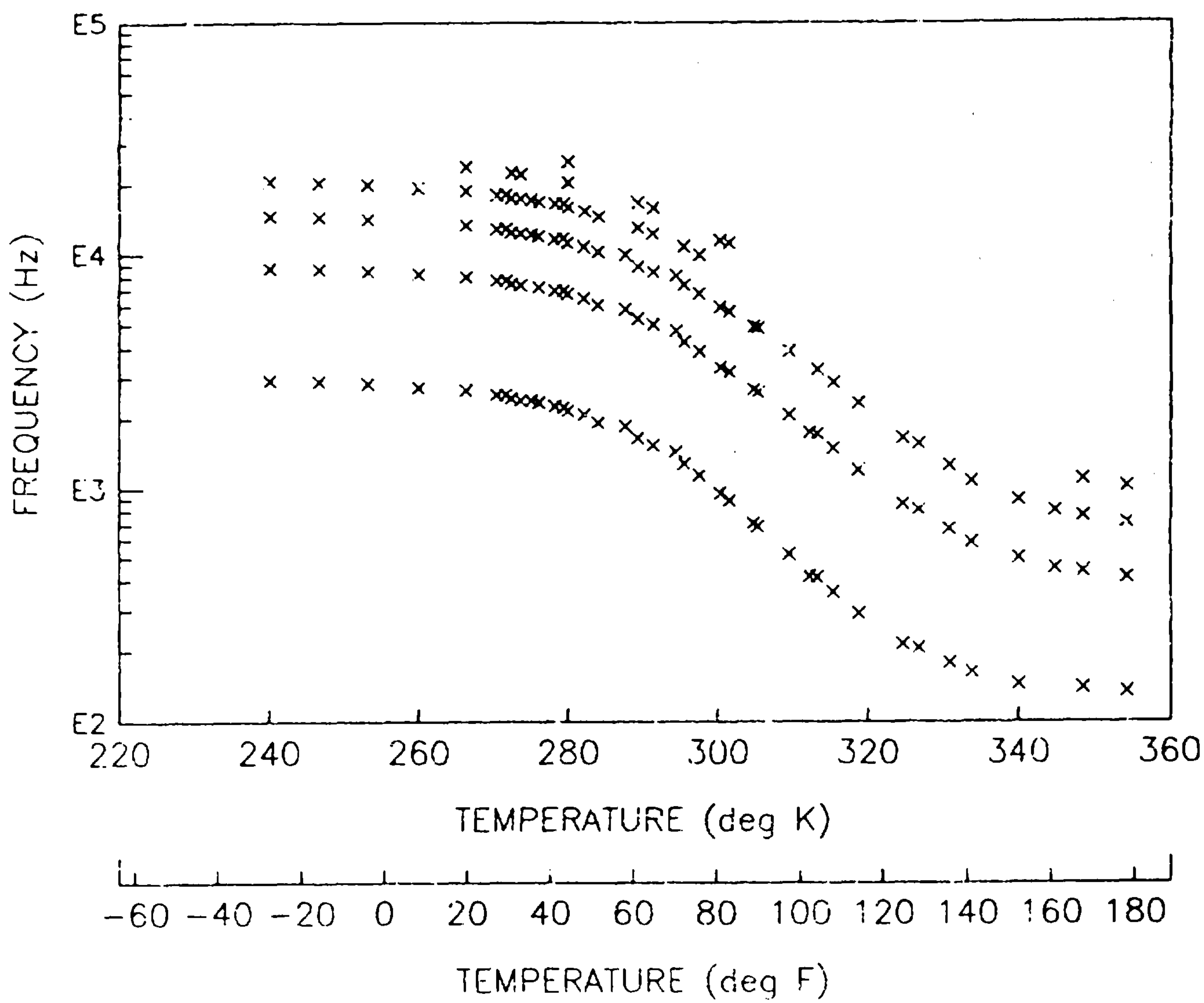

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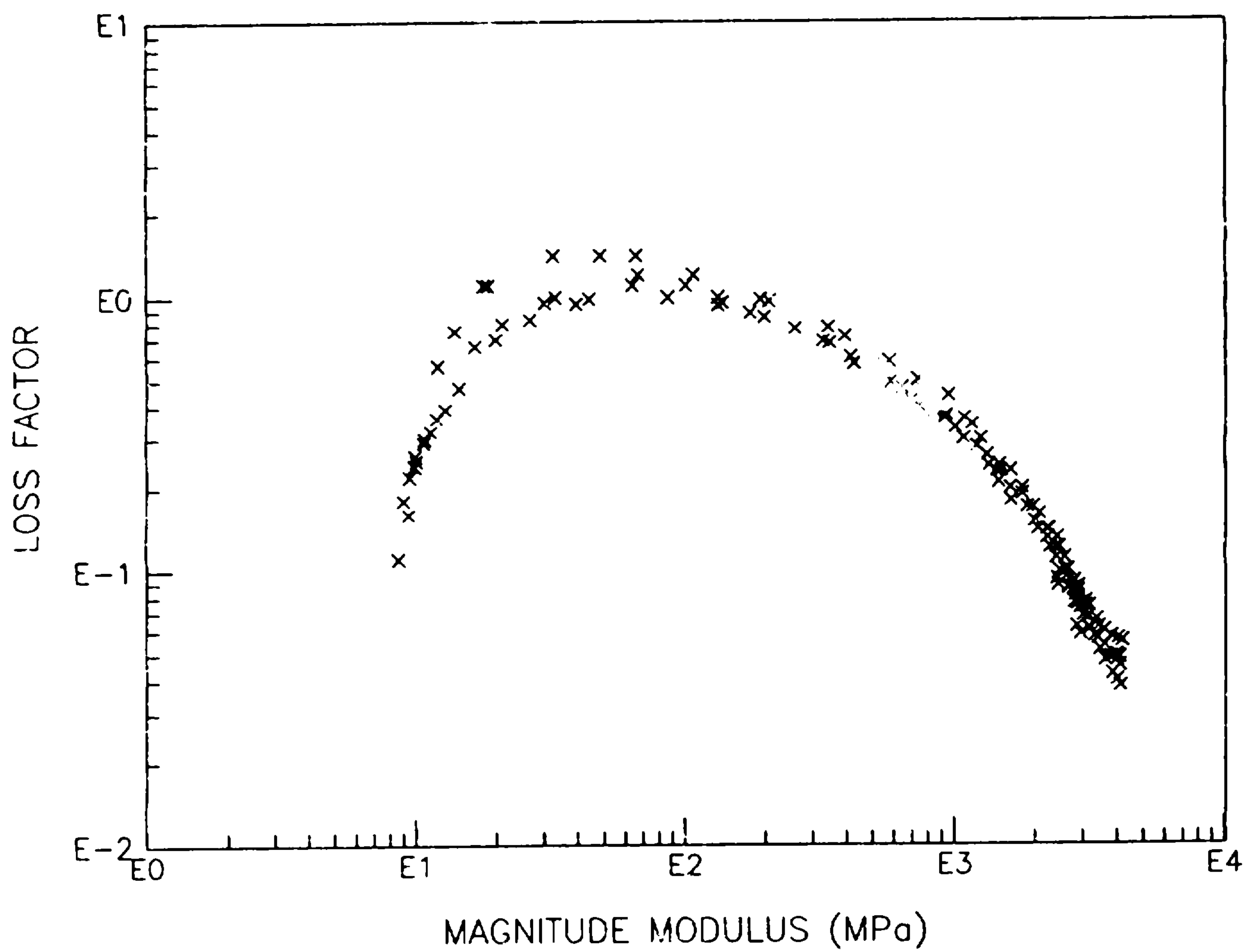

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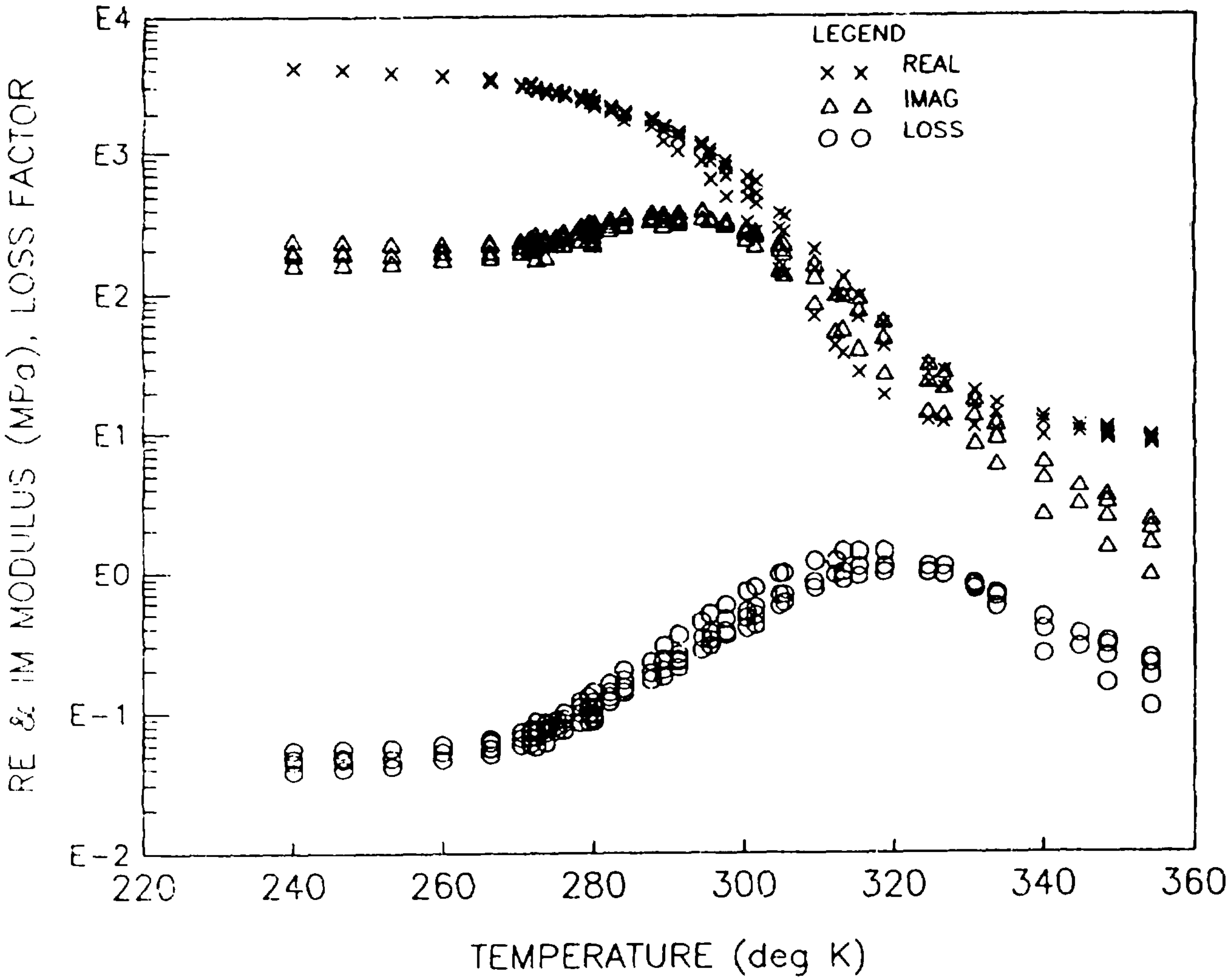

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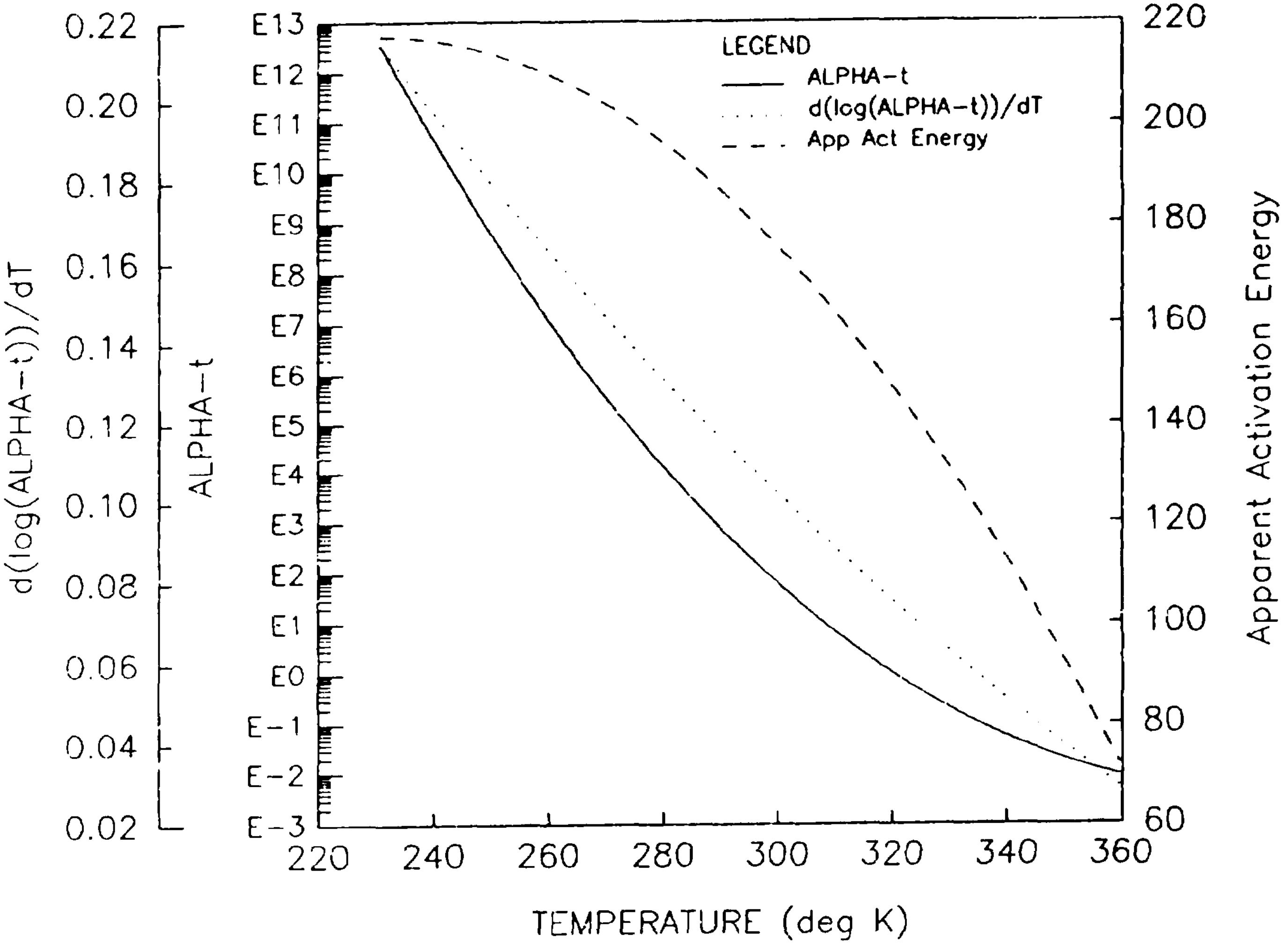


POLYURETHANE 24-8-1 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	320.0	230.0	360.0	0.7530E-01	0.2154	0.2860E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	7.801	4839.	0.1900E+07	0.5872	1.900	0.9000E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

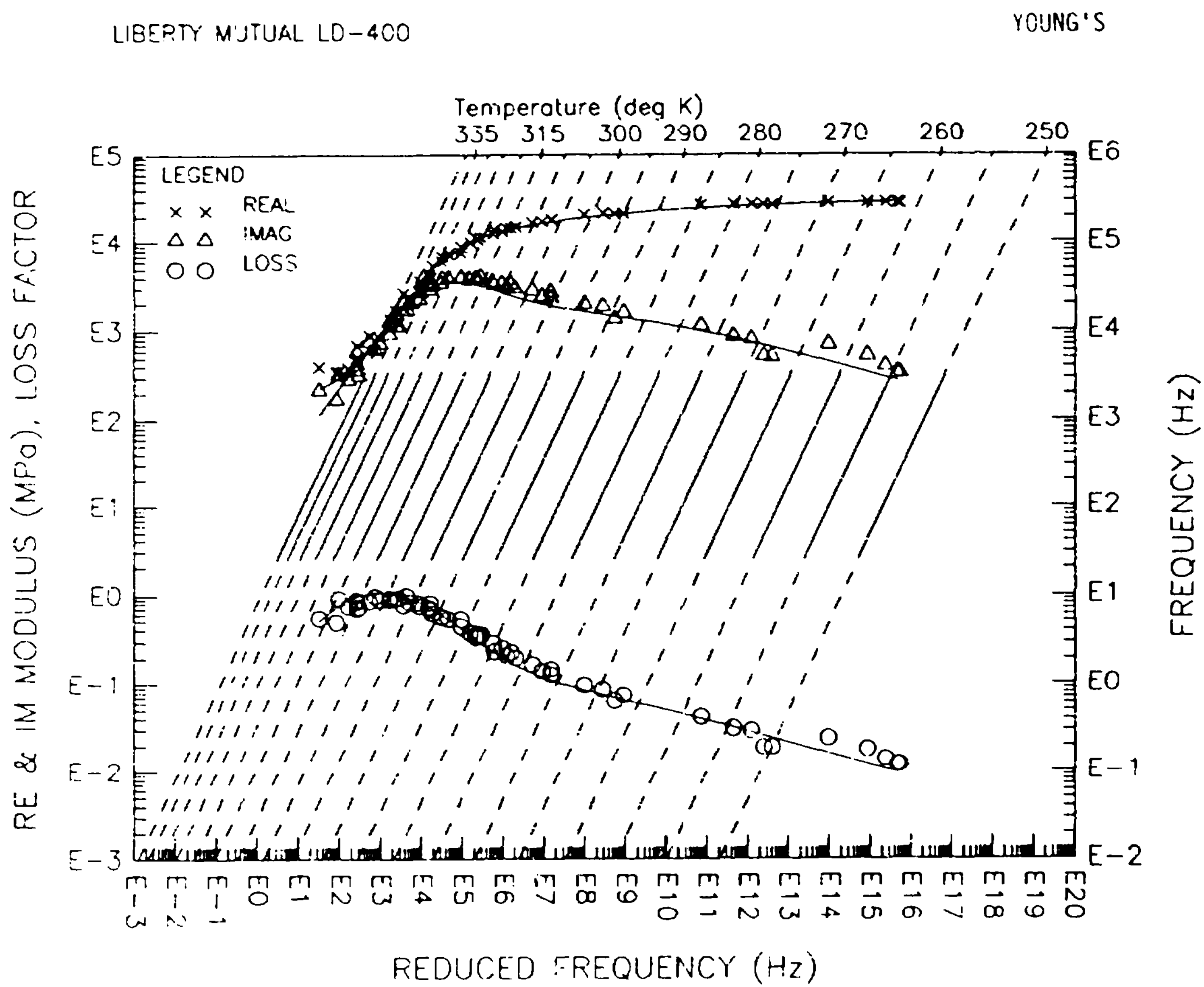
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
239.9	2950.	4140.	0.5500E-01	227.7
246.5	2910.	3990.	0.5600E-01	223.4
253.0	2830.	3780.	0.5700E-01	215.5
259.8	2730.	3540.	0.6000E-01	212.4
266.2	2650.	3330.	0.6600E-01	219.8
270.3	2530.	3030.	0.7400E-01	224.2
271.5	2530.	3030.	0.7700E-01	233.3
272.2	2450.	2840.	0.8700E-01	247.1
273.5	2400.	2730.	0.8600E-01	234.8
274.9	2390.	2700.	0.8900E-01	240.3
275.9	2350.	2610.	0.1000	261.0
278.1	2260.	2410.	0.1200	289.2
279.2	2240.	2360.	0.1300	306.8
279.8	2170.	2200.	0.1400	308.0
282.0	2080.	2020.	0.1600	323.2
283.9	1930.	1730.	0.2000	346.0
287.5	1850.	1560.	0.2300	358.8
289.1	1640.	1190.	0.3000	357.0
291.1	1530.	1010.	0.3600	363.6
294.2	1430.	858.0	0.4400	377.5
295.3	1270.	648.0	0.5000	324.0
297.4	1140.	492.0	0.5800	285.4
300.2	952.0	315.0	0.7200	226.8
301.4	890.0	266.0	0.7800	207.5
304.6	707.0	146.0	0.9700	141.6
305.2	683.0	135.0	0.9800	132.3
309.3	518.0	67.80	1.200	81.36
312.1	418.0	42.30	1.200	50.76
313.1	414.0	37.80	1.400	52.92
315.2	360.0	27.90	1.400	39.06
318.6	291.0	18.60	1.400	26.04
324.5	215.0	12.30	1.100	13.53
326.6	208.0	11.80	1.100	12.98
330.7	179.0	11.00	0.7500	8.250
333.6	164.0	10.40	0.5600	5.824
339.9	145.0	9.540	0.2600	2.480
348.4	140.0	9.150	0.1600	1.464
354.2	134.0	8.460	0.1100	0.9306
239.9	8790.	4050.	0.4800E-01	194.4
246.5	8670.	3960.	0.4900E-01	194.0

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
253.0	8490.	3780.	0.4800E-01	181.4
259.8	8250.	3570.	0.5300E-01	189.2
266.2	8030.	3390.	0.6200E-01	210.2
270.3	7690.	3090.	0.6700E-01	207.0
271.5	7710.	3120.	0.7400E-01	230.9
272.2	7490.	2940.	0.7600E-01	223.4
273.5	7370.	2840.	0.8400E-01	238.6
275.9	7220.	2730.	0.9100E-01	248.4
278.1	6980.	2540.	0.1100	279.4
279.2	6960.	2530.	0.1100	278.3
279.8	6740.	2360.	0.1200	283.2
282.0	6460.	2160.	0.1400	302.4
283.9	6080.	1910.	0.1700	324.7
287.5	5820.	1730.	0.1900	328.7
289.1	5310.	1430.	0.2300	323.9
291.1	5040.	1270.	0.2600	330.2
294.2	4750.	1090.	0.3400	370.6
295.3	4250.	864.0	0.3700	319.7
297.4	3890.	687.0	0.4600	316.0
300.2	3340.	489.0	0.5200	254.3
301.4	3180.	435.0	0.5600	243.6
304.6	2670.	283.0	0.6800	192.4
305.2	2610.	266.0	0.6900	183.5
309.3	2070.	149.0	0.8500	126.7
312.1	1740.	98.40	0.9600	94.46
313.1	1720.	93.00	1.000	93.00
316.2	1490.	66.90	1.100	73.59
318.6	1200.	42.30	1.100	46.53
324.5	656.0	2[illegible].00	1.000	23.00
326.6	614.0	21.40	0.9600	20.54
330.7	665.0	16.10	0.8000	12.88
333.6	585.0	13.70	0.6600	9.042
339.9	499.0	11.80	0.3900	4.602
344.7	454.0	10.20	0.2900	2.958
348.4	440.0	9.660	0.2500	2.415
354.2	412.0	8.730	0.1800	1.571
239.9	0.1470E+05	4050.	0.4500E-01	182.3
246.5	0.1460E+03	3960.	0.4700E-01	186.1
253.0	0.1420E+05	3780.	0.4800E-01	181.4
266.2	0.1340E+05	3360.	0.5600E-01	188.2
270.3	0.1280E+05	3060.	0.6700E-01	205.0
271.5	0.1290E+05	3090.	0.6800E-01	210.1
272.2	0.1240E+05	2900.	0.7300E-01	211.7
273.5	0.1230E+05	2830.	0.7800E-01	220.7
274.9	0.1220E+05	2780.	0.8100E-01	225.2
275.9	0.1200E+05	2710.	0.8500E-01	230.4
278.1	0.1160E+05	2640.	0.1000	264.0
279.2	0.1170E+05	2570.	0.9900E-01	254.4
279.8	0.1120E+05	2360.	0.1100	259.6
282.0	0.1080E+05	2180.	0.1300	283.4
283.9	0.1030E+05	1950.	0.1500	292.5
287.5	9940.	1820.	0.1700	309.4
289.1	8890.	1420.	0.2400	340.8
291.1	8470.	1290.	0.2400	309.6
294.2	8100.	1160.	0.2800	324.8
295.3	7390.	951.0	0.3300	313.8
297.4	6780.	777.0	0.3800	295.3

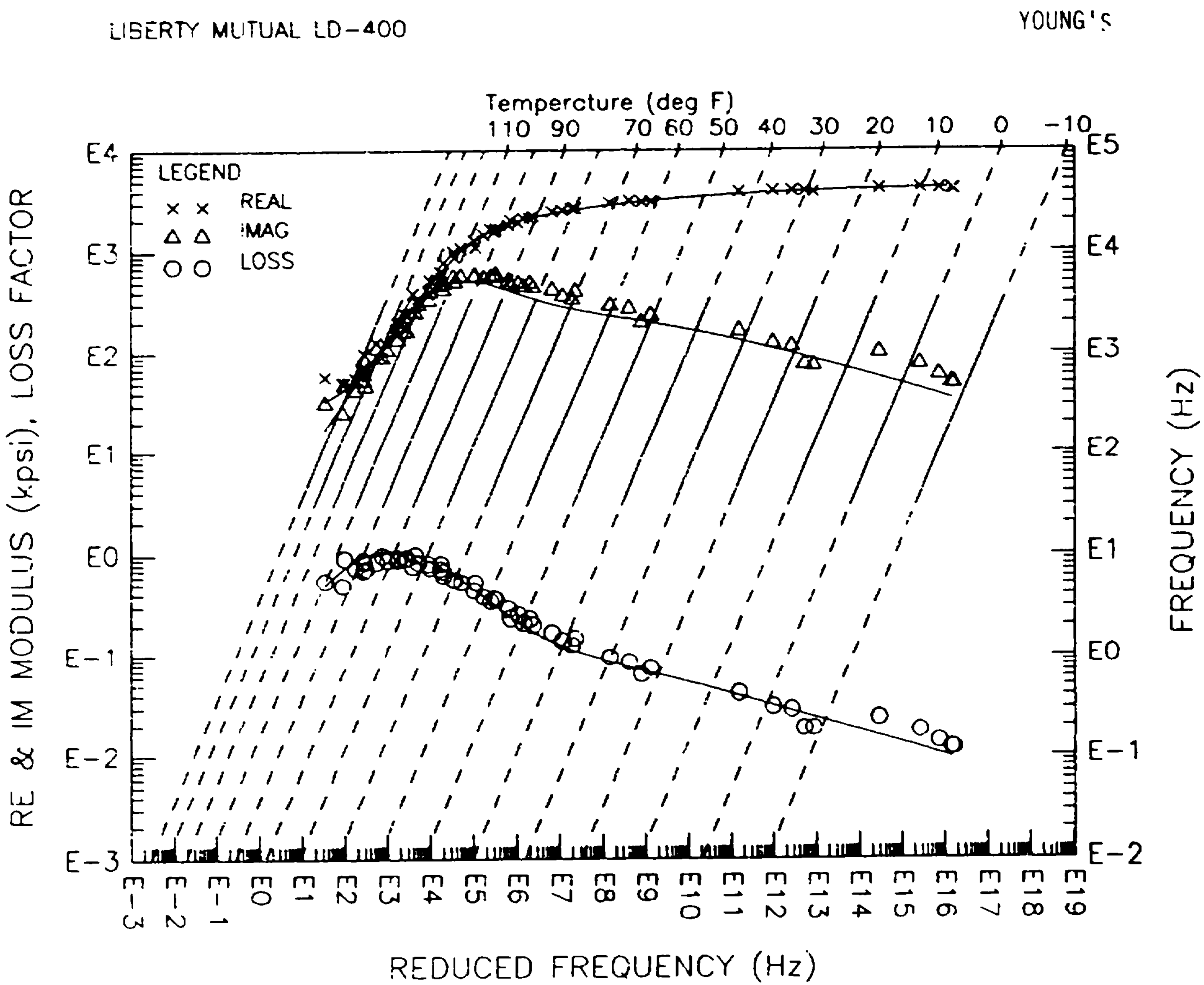
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
300.2	5950.	570.0	0.4700	267.9
301.4	5700.	516.0	0.4900	252.8
304.6	4930.	366.0	0.5700	208.6
305.2	4860.	351.0	0.6000	210.6
309.3	3890.	201.0	0.7700	154.8
313.1	3260.	130.0	0.8800	114.4
315.2	2870.	96.00	0.9400	90.24
318.6	2330.	60.30	1.000	60.30
324.5	1650.	30.90	0.9900	30.59
326.6	1560.	28.20	0.9500	26.79
330.7	1260.	20.10	0.8300	16.68
333.6	1080.	16.00	0.7000	11.20
339.9	896.0	12.90	0.4700	6.063
344.7	804.0	11.10	0.3600	3.996
348.4	759.0	10.20	0.3000	3.060
354.2	709.0	9.120	0.2200	2.006
239.9	0.2070E+05	4080.	0.3800E-01	155.0
246.5	0.2040E+05	3960.	0.4000E-01	158.4
253.0	0.2000E+05	3810.	0.4200E-01	160.0
259.8	0.1940E+05	3600.	0.4700E-01	169.2
266.2	0.1890E+05	3420.	0.5100E-01	174.4
270.3	0.1810E+05	3120.	0.6000E-01	187.2
271.5	0.1820E+05	3150.	0.6100E-01	192.2
272.2	0.1760E+05	2960.	0.6800E-01	201.3
273.5	0.1740E+05	2880.	0.7300E-01	210.2
274.9	0.1730E+05	2830.	0.7500E-01	212.3
275.9	0.1700E+05	2760.	0.7600E-01	209.8
278.1	0.1660E+05	2610.	0.8600E-01	224.5
279.2	0.1660E+05	2620.	0.8700E-01	227.9
279.8	0.1600E+05	2430.	0.9900E-01	240.6
282.0	0.1540E+05	2230.	0.1200	267.6
283.9	0.1460E+05	2010.	0.1400	281.4
289.1	0.1300E+05	1560.	0.2000	312.0
291.1	0.1230E+05	1380.	0.2300	317.4
295.3	0.1080E+05	1030.	0.3000	309.0
297.4	9930.	855.0	0.3600	307.8
300.2	0.1150E+05	678.0	0.4000	271.2
301.4	0.1120E+05	627.0	0.4200	263.3
348.4	1100.	10.70	0.3200	3.424
354.2	1020.	9.450	0.2400	2.268
266.2	0.2390E+05	3270.	0.5700E-01	186.4
272.2	0.2250E+05	2900.	0.5800E-01	168.2
273.5	0.2220E+05	2810.	0.6200E-01	174.2
289.1	0.1650E+05	1580.	0.1800	284.4
291.1	0.1590E+05	1410.	0.2100	296.1
279.8	0.2500E+05	2370.	0.9300E-01	220.4
279.3	0.2050E+05	2390.	0.8800E-01	210.3

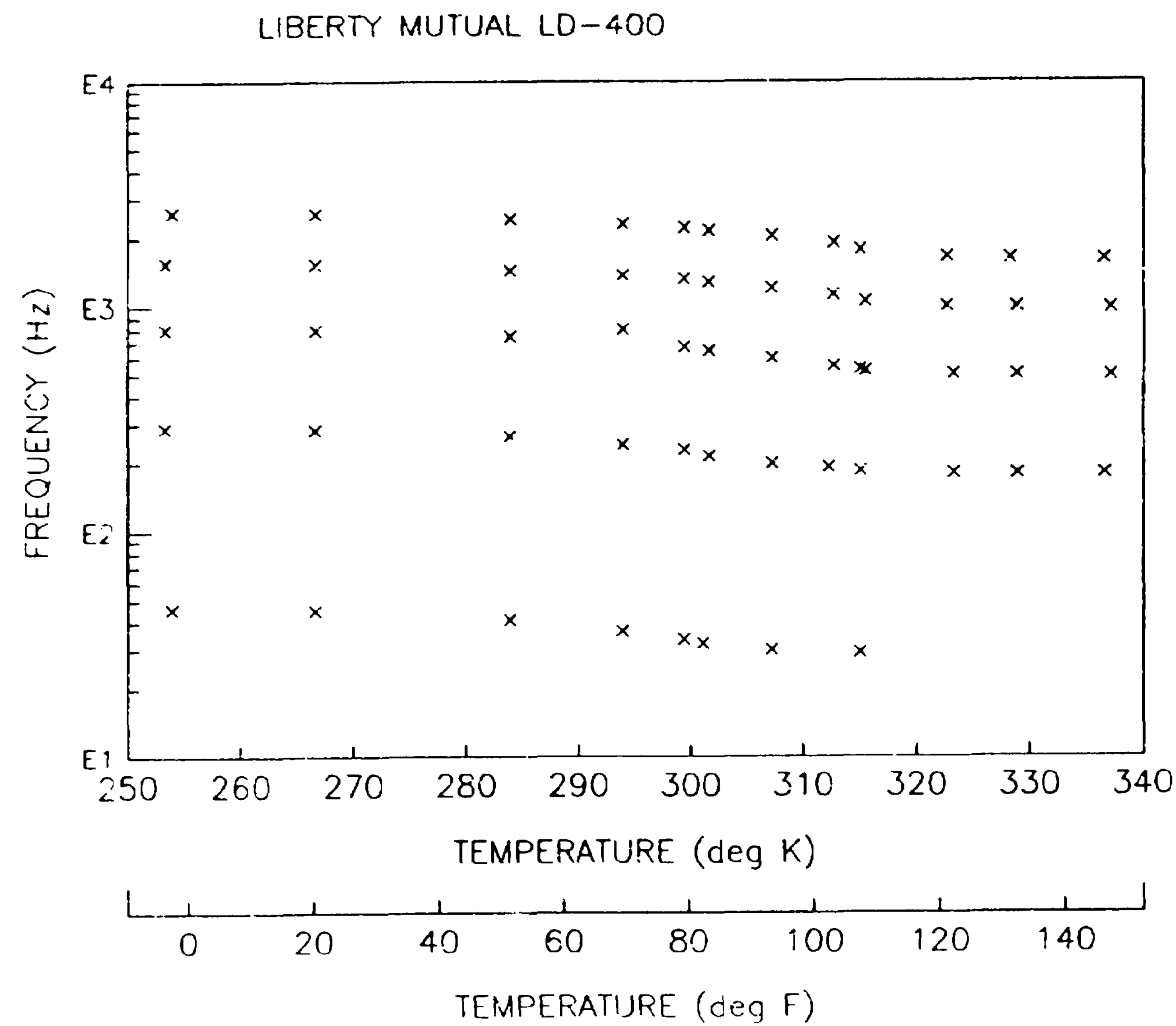
LIBERTY MUTUAL LD-400 YOUNG'S

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.9397E-02	0.7656	1.094	0.7656	0.4979
MODULUS	MPA	0.2891E+05	4034.	905.4	323.9	228.6
	PSI	0.4192E+07	0.5851E+06	0.1313E+06	0.4698E+05	0.3316E+05
10.HZ	DEG K		298.0	306.0	314.0	
	DEG C		4.850	12.85	20.85	
	DEG F		40.73	55.13	69.53	
100.HZ	DEG K		305.0	315.0	325.0	
	DEG C		11.85	21.85	31.85	
	DEG F		53.33	71.33	89.33	
1000.HZ	DEG K		313.0	325.0	340.0	
	DEG C		19.85	31.85	46.85	
	DEG F		67.73	89.33	116.3	

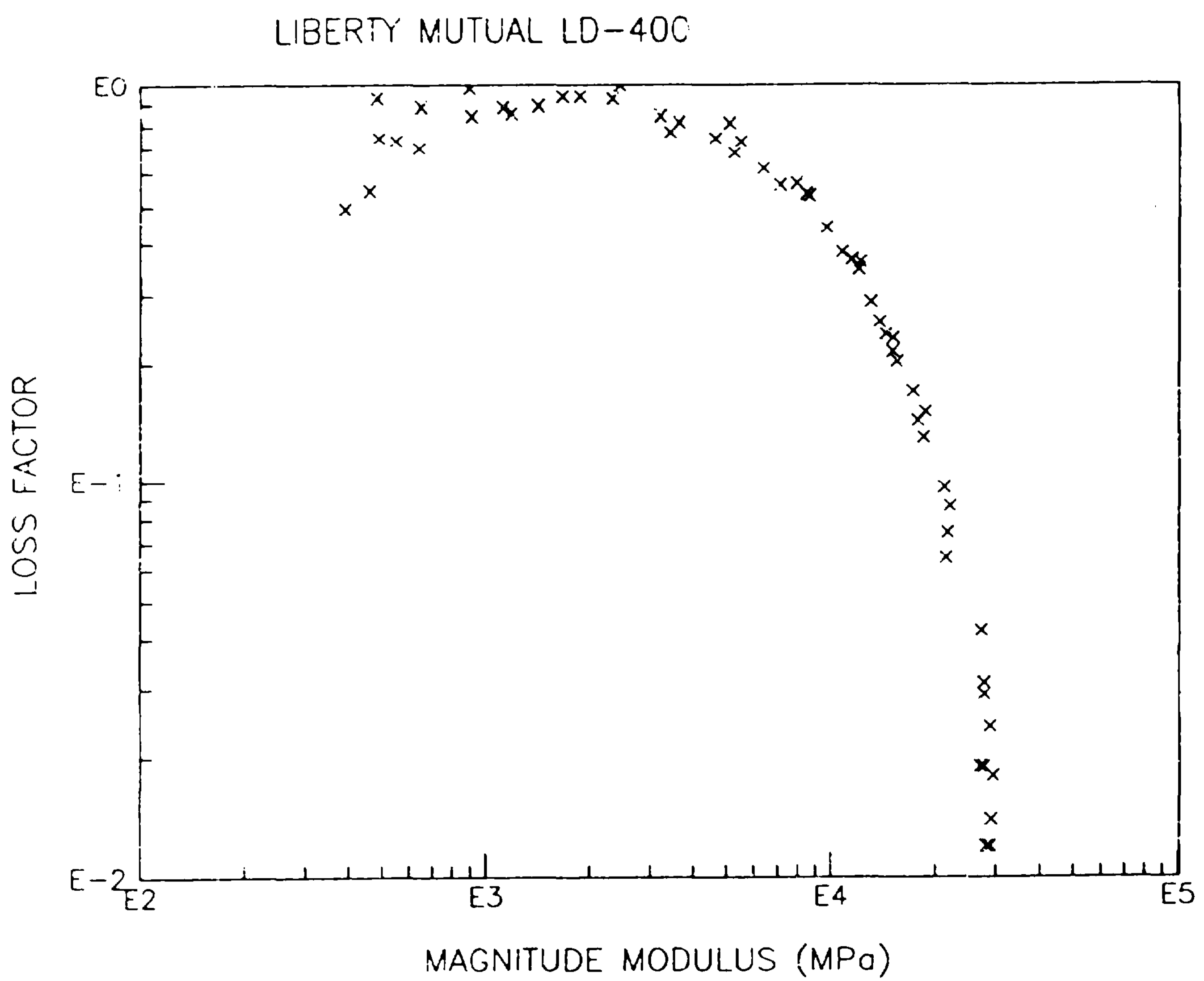


LIBERTY MUTUAL LD-400
YOUNG'S
Temperature (deg K)
335 315 300 290 280 270 260 250
LEGEND
REAL
IMAG
LOSS
E5 E4 E3 E2 E1 E0 E−1 E−2 E−3
RE & IM MODULUS (MPa), LOSS FACTOR
E6 E5 E4 E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20
REDUCED FREQUENCY (Hz)

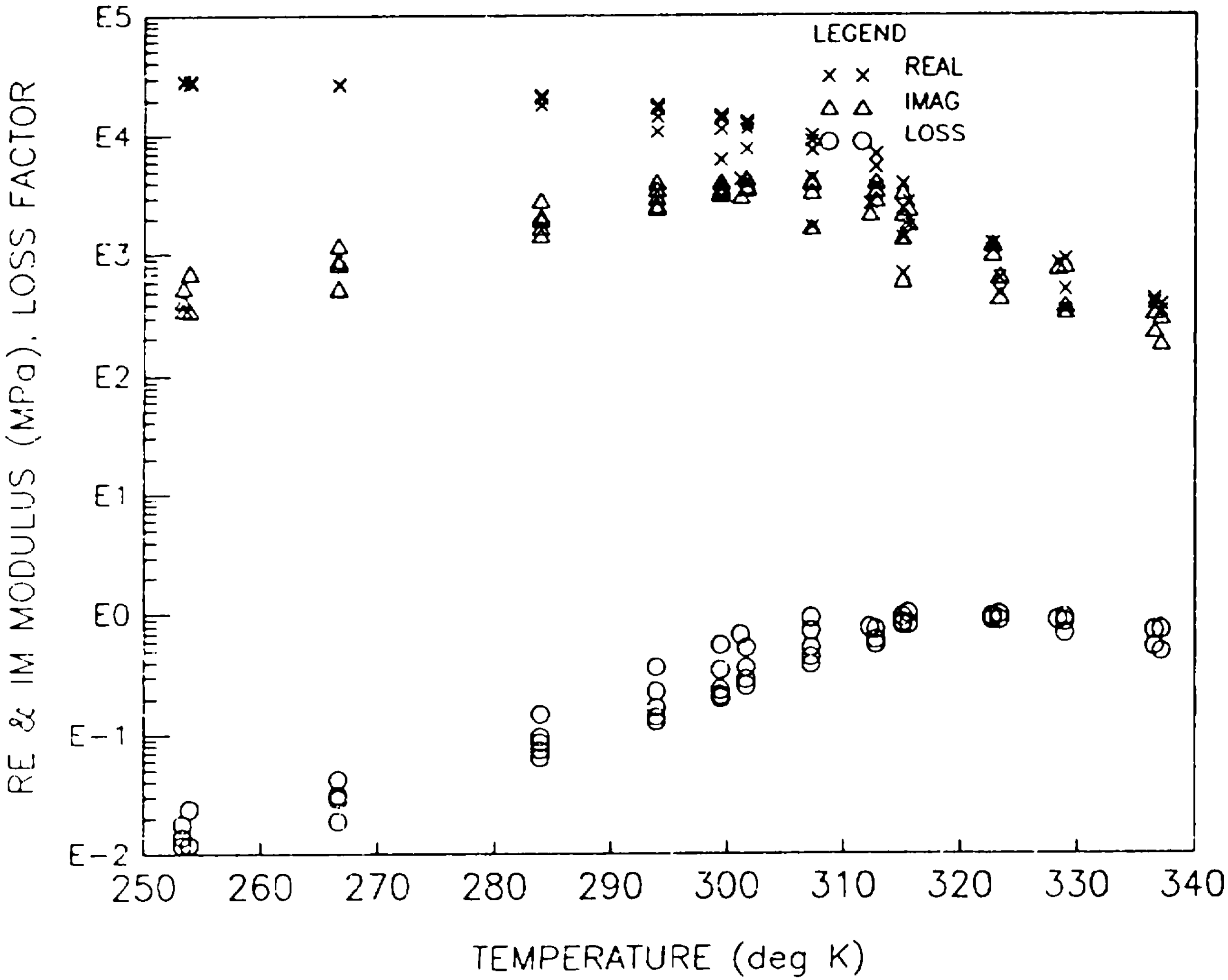

LIBERTY MUTUAL LD-400
YOUNG'S
Temperature (deg F)
110 90 70 60 50 40 30 20 10 0 -10
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E4 E3 E2 E1 E0 E-1 E-2 E-3
E5 E4 E3 E2 E1 E0 E-1 E-2
FREQUENCY (Hz)
E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19
REDUCED FREQUENCY (Hz)



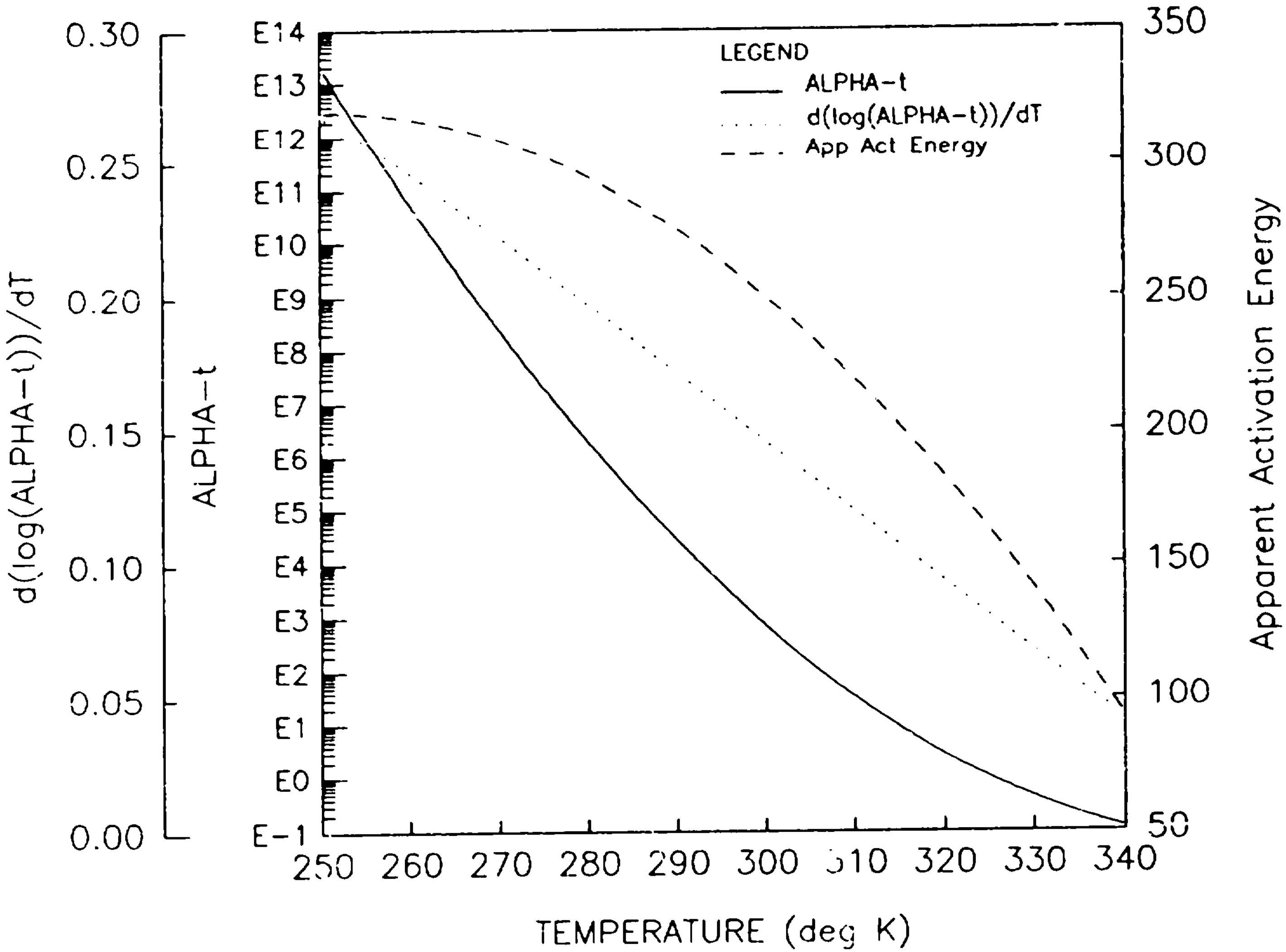
LIBERTY MUTUAL LD-400
FREQUENCY (Hz)
E4
E3
E2
E1
250
260
270
280
290
300
310
320
330
340
TEMPERATURE (deg K)
0
20
40
60
80
100
120
140
TEMPERATURE (deg F)


LIBERTY MUTUAL LD-400
LOSS FACTOR
E0
E-1
E-2
E2
E3
E4
E5
MAGNITUDE MODULUS (MPa)

LIBERTY MUTUAL LD-400



LIBERTY MUTUAL LD-400



LIBERTY MUTUAL LD-400 YOUNG'S

ALFA-T MODEL

NALP	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	325.0	250.0	340.0	0.8058E-01	0.2684	0.4218E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	160.0	0.3000E+05	0.1022E+06	0.6666	1.467	0.1418

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

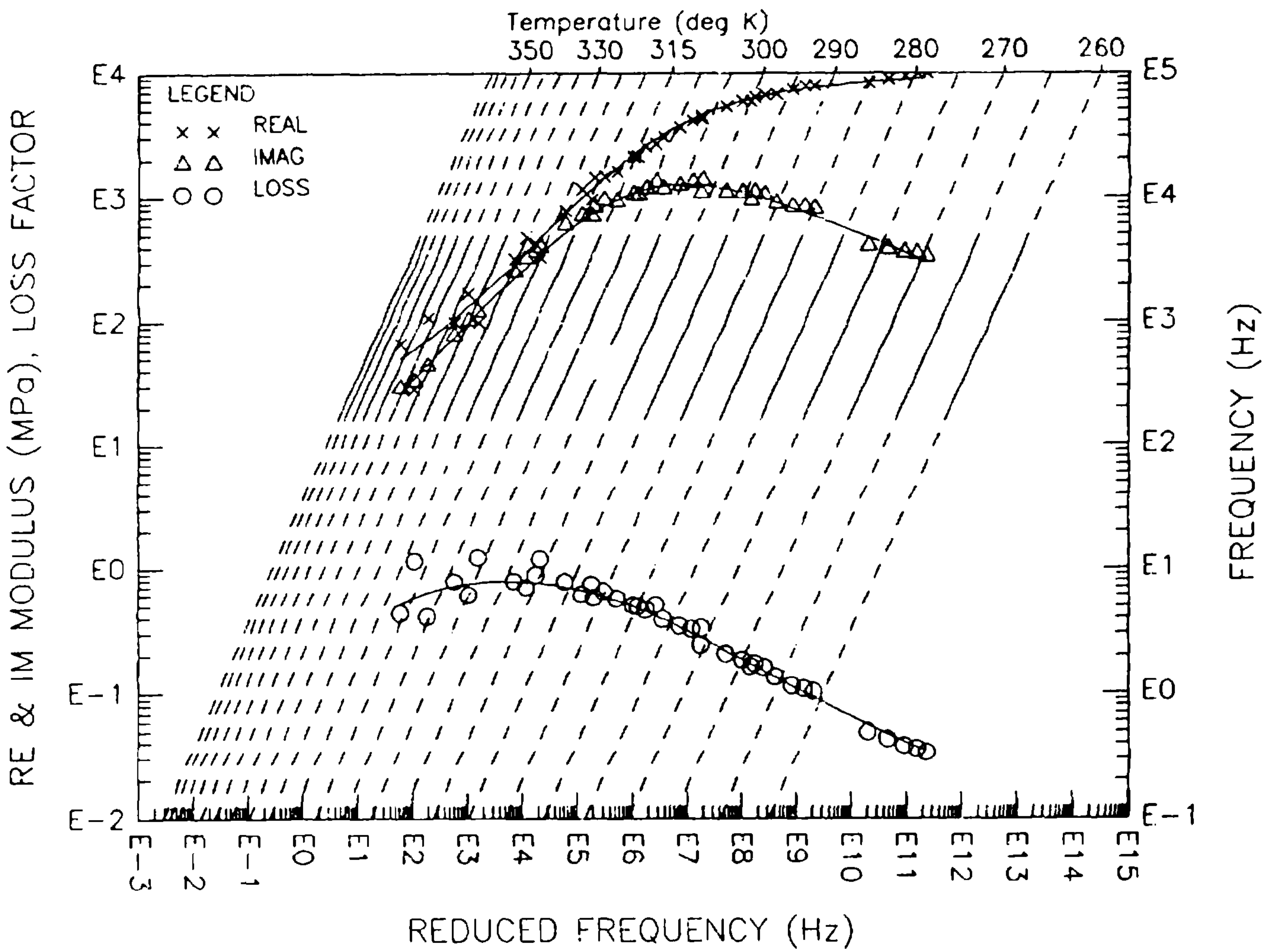
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
336.5	178.2	401.0	0.5430	217.7
337.1	497.3	347.0	0.4930	171.1
337.1	977.7	389.0	0.7420	288.6
336.5	1619.	438.0	0.7310	320.2
322.6	1663.	1210.	0.9340	1130.
322.6	1001.	1050.	0.8900	934.5
323.2	503.3	637.0	0.9780	623.0
323.2	179.1	482.0	0.8860	427.1
307.1	199.7	4390.	0.7280	3196.
307.1	596.5	7400.	0.5320	3937.
307.1	1206.	8830.	0.4410	3894.
307.1	2038.	0.1000E+05	0.3790	3790.
307.1	29.90	1700.	0.9230	1569.
299.3	229.6	0.1130E+05	0.3430	3876.
299.3	669.3	0.1390E+05	0.2360	3280.
299.3	1329.	0.1460E+05	0.2130	3110.
299.3	2214.	0.1510E+05	0.2020	3050.
299.3	33.40	6150.	0.5600	3444.
293.8	242.3	0.1460E+05	0.2310	3373.
293.8	1385.	0.1750E+05	0.1420	2485.
293.8	800.2	0.1690E+05	0.1700	2873.
293.8	2310.	0.1820E+05	0.1290	2348.
293.8	36.50	0.1070E+05	0.3630	3884.
283.8	263.8	0.2090E+05	0.9600E-01	2006.
283.8	745.2	0.2180E+05	0.8600E-01	1875.
283.8	1454.	0.2130E+05	0.6400E-01	1363.
283.8	2408.	0.2150E+05	0.7400E-01	1591.
283.8	41.00	0.1840E+05	0.1500	2760.
266.5	283.5	0.2750E+05	0.3100E-01	852.5
266.5	792.5	0.2750E+05	0.2900E-01	797.5
266.5	1556.	0.2740E+05	0.1900E-01	520.6
266.5	2552.	0.2680E+05	0.1900E-01	509.2
266.5	45.20	0.2690E+05	0.4200E-01	1130.
253.2	288.1	0.2910E+05	0.1800E-01	523.8
253.2	803.7	0.2890E+05	0.1400E-01	404.6
253.2	1575.	0.2850E+05	0.1200E-01	342.0
253.8	2583.	0.2800E+05	0.1200E-01	336.0
301.5	643.6	0.1140E+05	0.3580	4081.
283.8	46.10	0.2860E+05	0.2400E-01	686.4
301.5	1284.	0.1240E+05	0.2870	3559.

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
301.5	2151.	0.1330E+05	0.2840	3378.
301.0	32.00	4300.	0.6790	2920.
301.5	214.5	7600.	0.5280	4013.
315.4	520.4	1720.	0.9960	1713.
315.4	1052.	2790.	0.8140	2271.
314.9	1790.	3910.	0.8100	3167.
314.9	184.1	1360.	0.9360	1273.
314.9	29.00	689.0	0.8430	580.8
314.9	530.7	2430.	0.8430	2048.
328.8	178.2	352.0	0.9260	326.0
328.8	500.8	521.0	0.6990	364.2
328.8	994.6	893.0	0.8540	762.6
328.2	1642.	832.0	0.8840	735.5
312.6	548.3	3670.	0.7430	2727.
312.6	1122.	5380.	0.6150	3309.
312.6	1915.	6870.	0.5630	3868.
312.1	191.1	2680.	0.7700	2064.

E-A-R EXODAMP C 2003 YOUNG'S

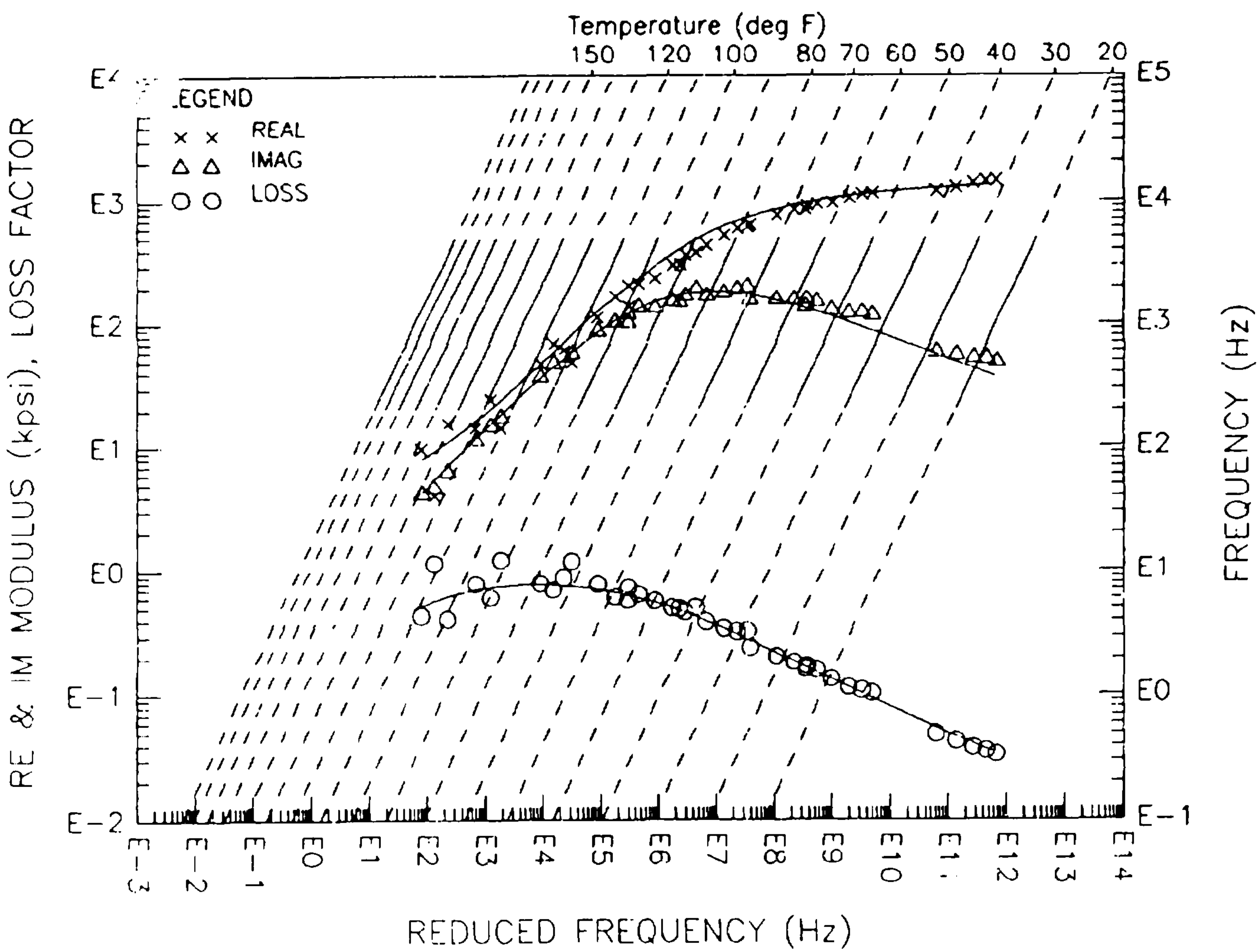
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.3427E-01	0.5404	0.7720	0.5404	0.5138
MODULUS	MPA	8991.	1912.	250.6	57.10	50.87
	PSI	0.1304E+07	0.2773E+06	0.3635E+05	8281.	7378.
10.HZ	DEG K		289.0	306.0	323.0	
	DEG C		-4.150	12.85	29.85	
	DEG F		24.53	55.13	85.73	
100.HZ	DEG K		297.0	316.0	336.0	
	DEG C		3.850	22.85	42.85	
	DEG F		38.93	73.13	109.1	
1000.HZ	DEG K		305.0	327.0	355.0	
	DEG C		11.85	33.85	61.85	
	DEG F		53.33	92.93	143.3	

E-A-R EXODAMP C 2003 YOUNG'S

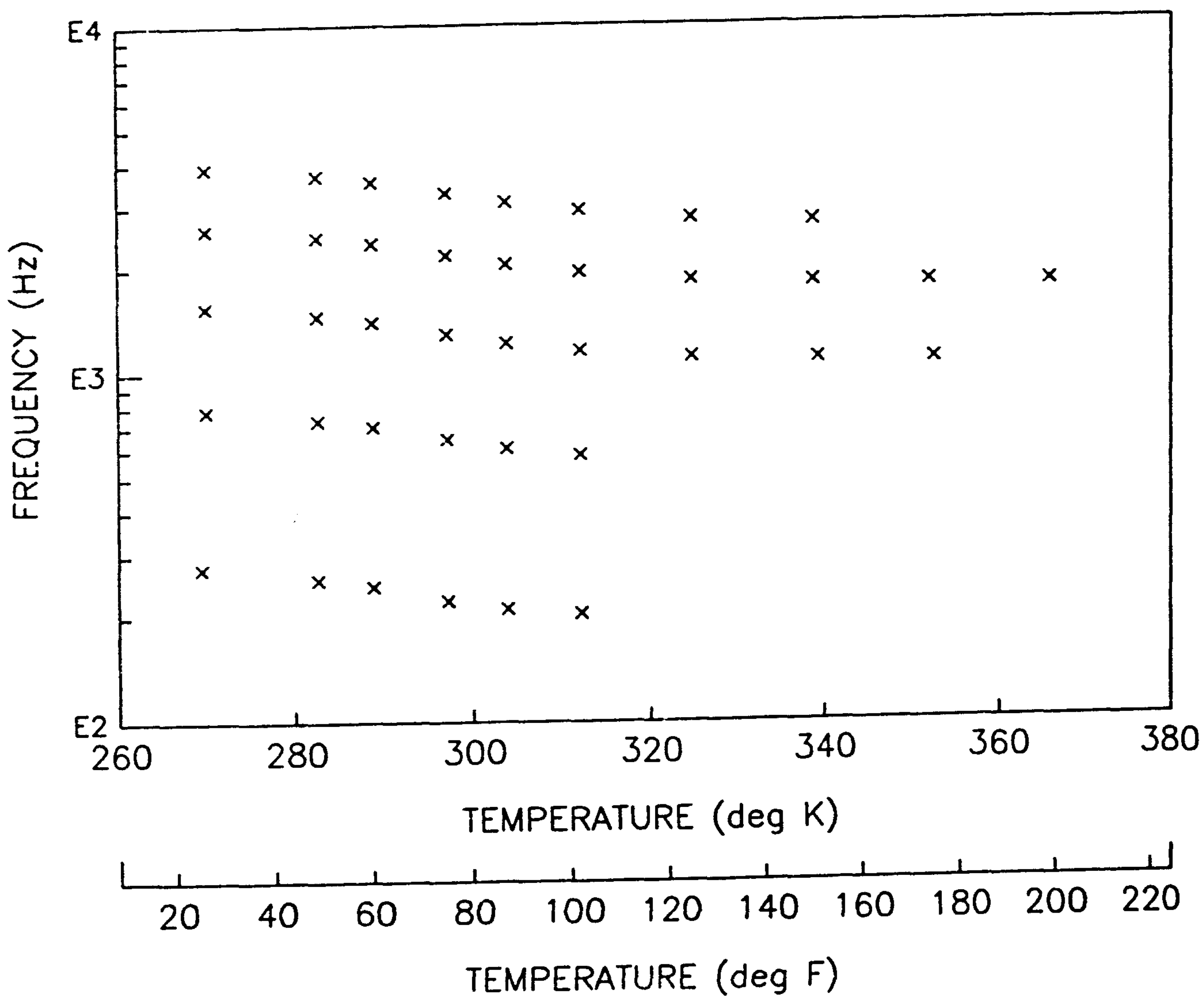


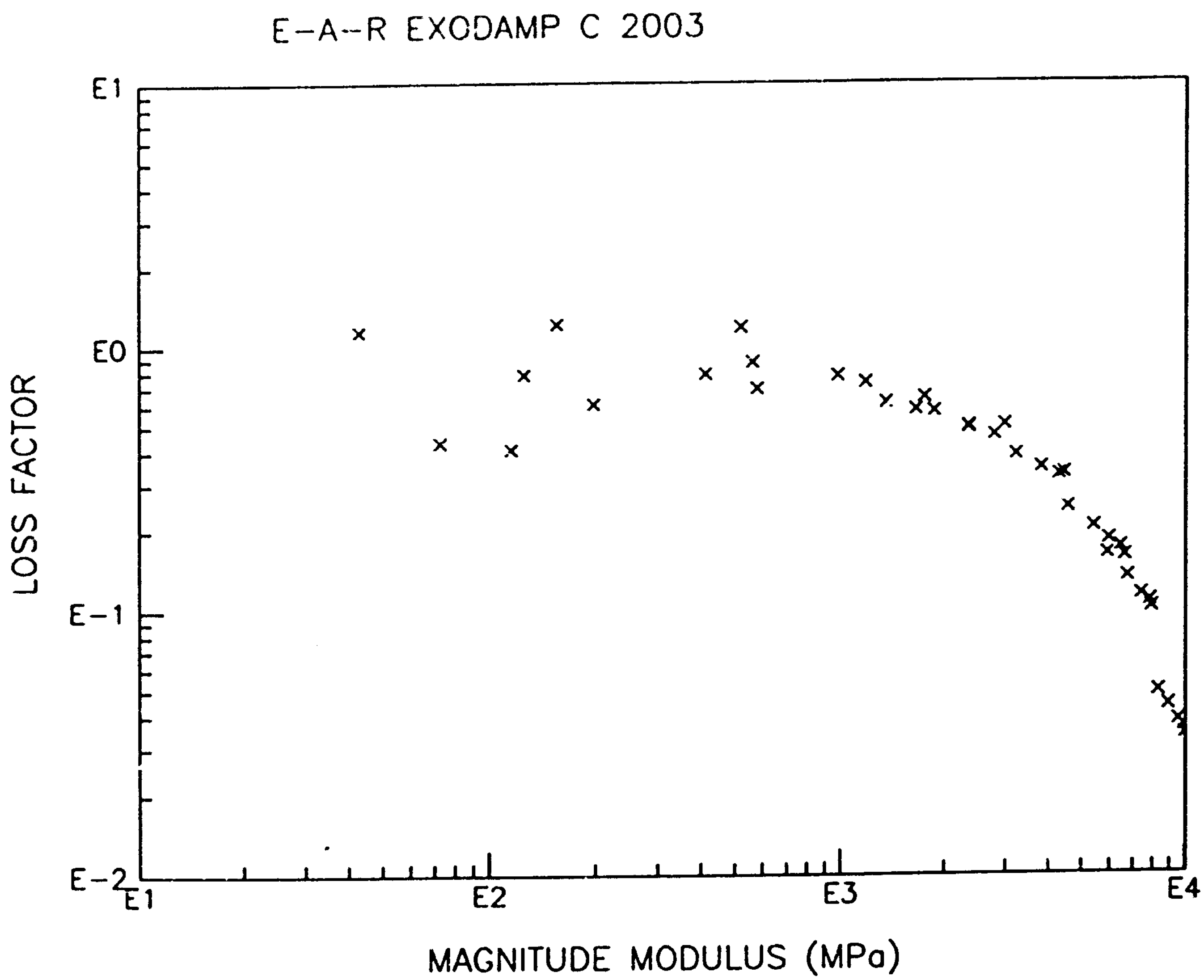
E-A-R EXODAMP C 2003

YOUNG'S

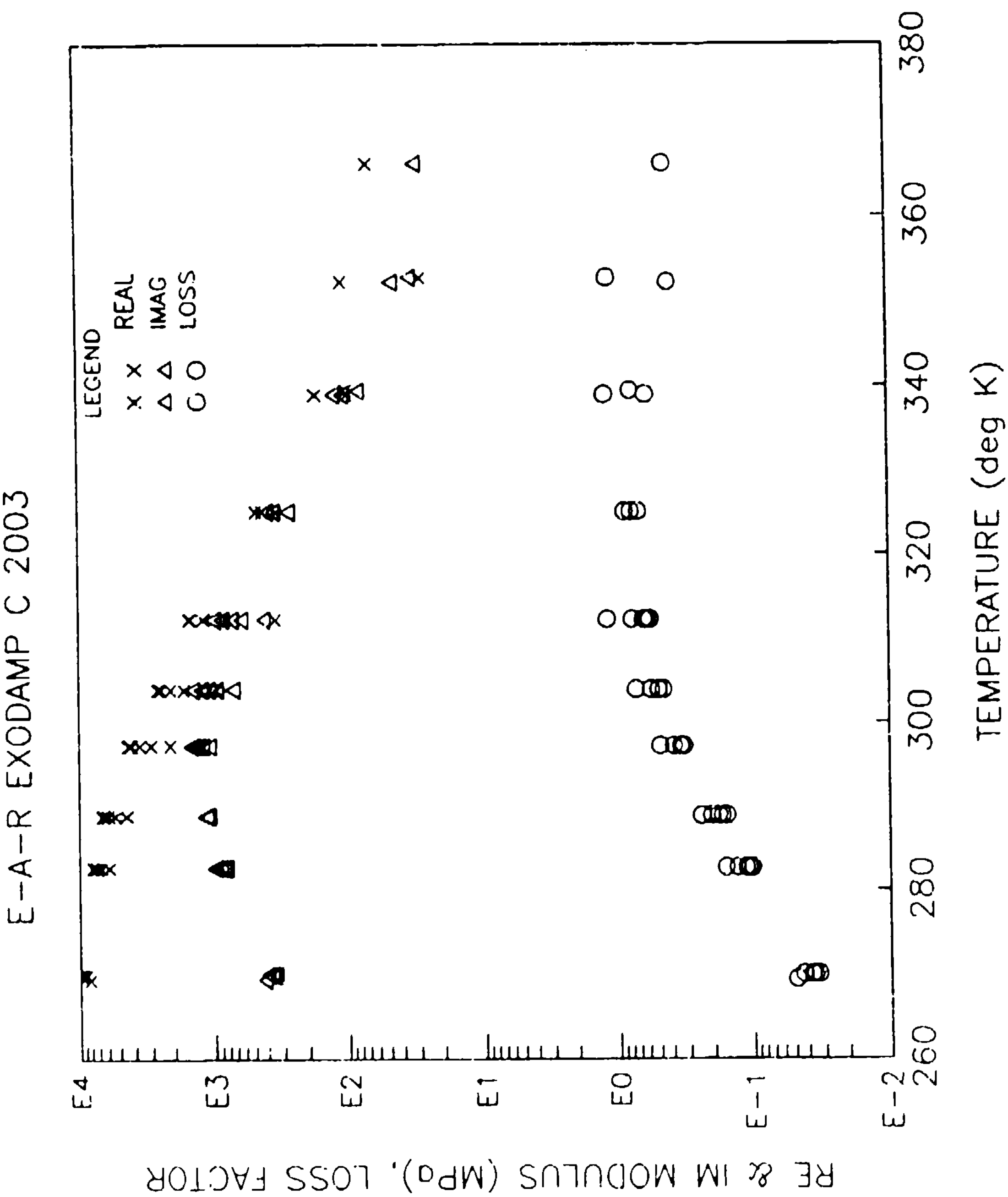


E-A-R EXODAMP C 2003

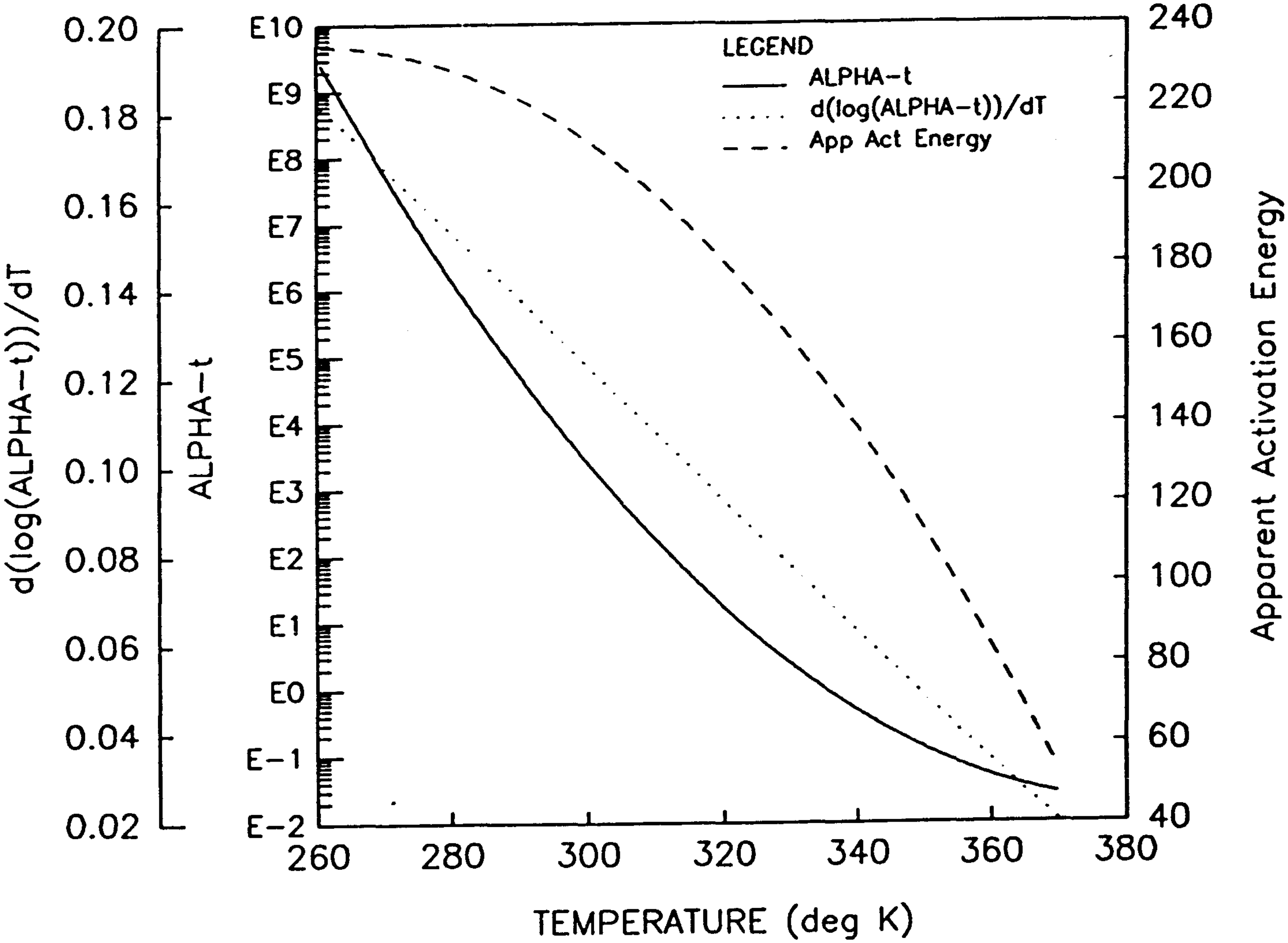




E-A-R EXODAMP C 2003
E1
E0
E-1
E-2
LOSS FACTOR
E1
E2
E3
E4
MAGNITUDE MODULUS (MPa)


E-A-R EXODAMP C 2003
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
E-1
E-2
260
280
300
320
340
360
380
TEMPERATURE (deg K)

E-A-R EXODAMP C 2003



E-A-R EXODAMP C 2003 YOUNG'S

ALFA-T MODEL

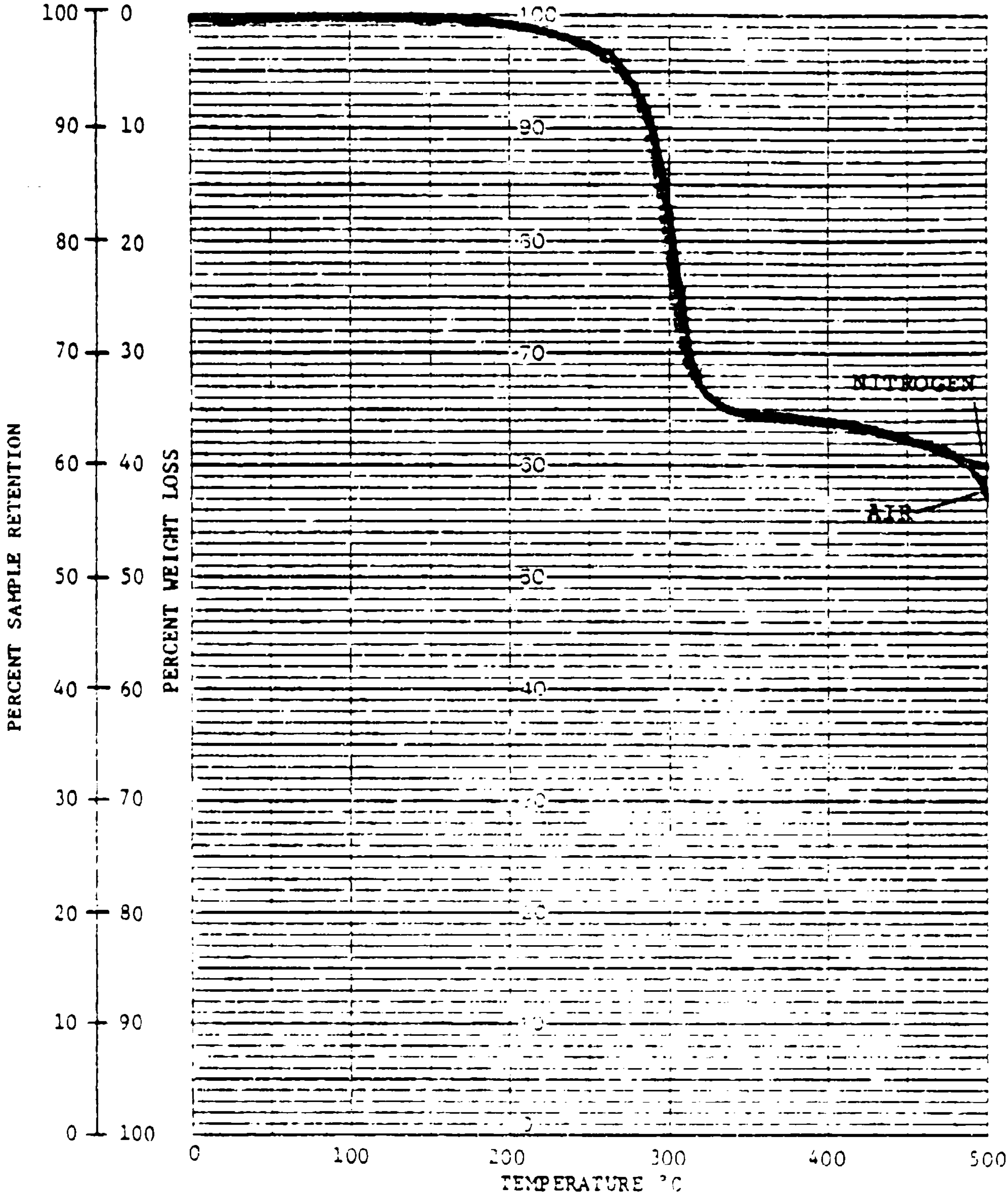
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	335.0	260.0	370.0	0.7000E-01	0.1820	0.2000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	23.37	0.1000E+05	0.4272E+07	0.4950	0.9658	0.1954

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

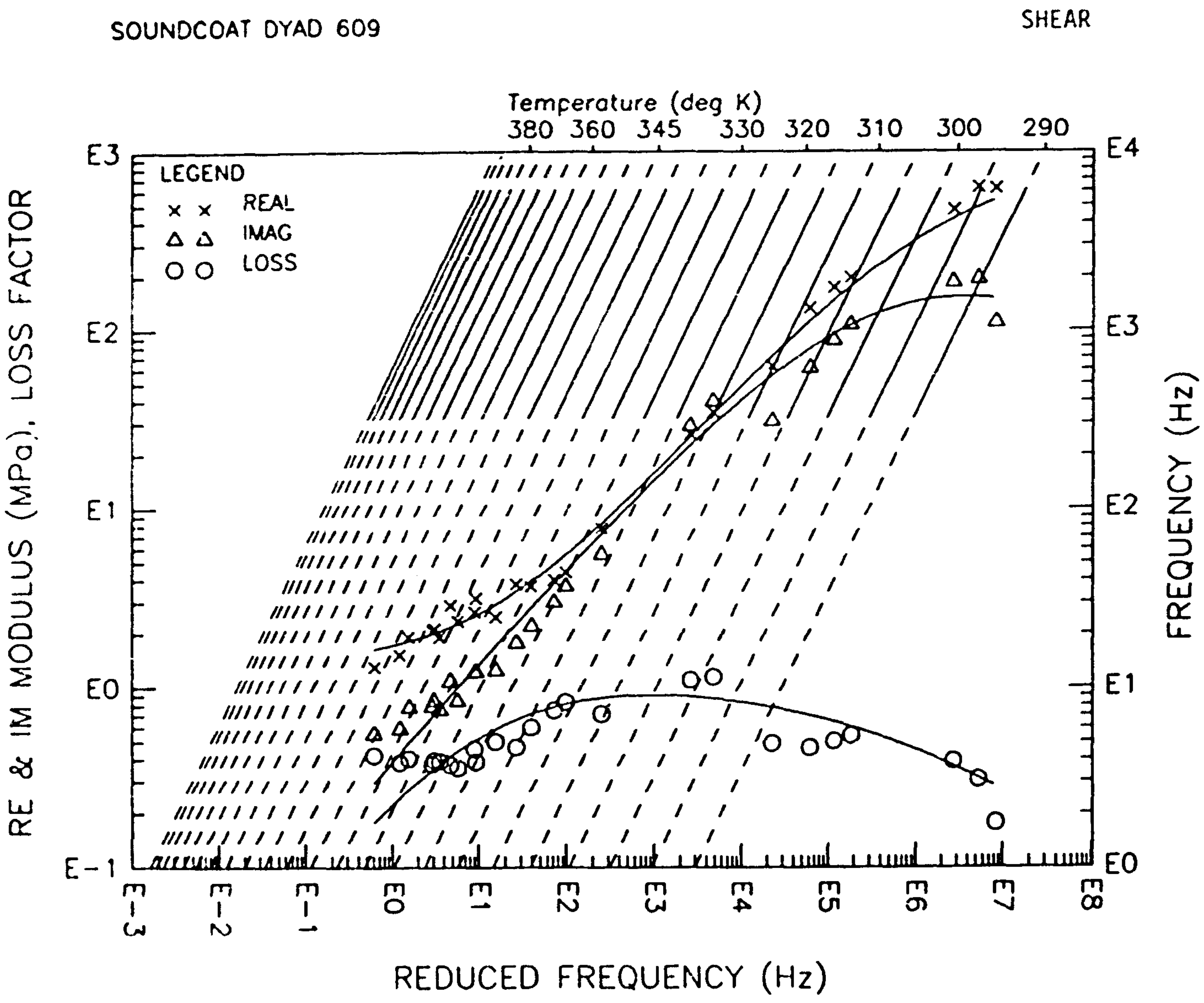
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
312.1	203.4	336.0	1.189	399.5
312.1	579.2	776.0	0.7779	603.7
312.1	1158.	1160.	0.6110	708.8
312.1	1944.	1440.	0.5752	828.3
312.1	2929.	1460.	0.6406	948.1
324.9	1842.	475.0	0.6952	330.2
324.9	2764.	423.0	0.8744	369.9
297.1	222.6	2110.	0.4896	1033.
297.1	644.7	3000.	0.3870	1161.
297.1	1293.	3600.	0.3448	1241.
297.1	2182.	4080.	0.3238	1321.
297.1	3291.	4210.	0.3289	1385.
282.6	266.5	5830.	0.1622	945.6
282.6	734.2	6670.	0.1332	888.4
282.6	1465.	7330.	0.1136	832.7
282.6	2457.	7780.	0.1075	836.4
282.6	3695.	7880.	0.1017	801.4
288.8	244.6	4430.	0.2433	1078.
288.8	702.6	5290.	0.2058	1089.
288.8	1402.	5870.	0.1840	1080.
288.8	2356.	6340.	0.1722	1092.
288.8	3556.	6550.	0.1593	1043.
303.8	210.3	955.0	0.7326	699.6
303.8	606.0	1630.	0.5659	922.4
303.8	1213.	2100.	0.4975	1045.
303.8	2048.	2530.	0.4600	1164.
303.8	3094.	2660.	0.5030	1338.
269.3	275.6	8270.	0.4900E-01	405.2
269.9	780.7	8860.	0.4330E-01	383.6
269.9	1552.	9480.	0.3780E-01	358.3
324.9	1103.	325.0	0.7871	255.3
269.9	2593.	9850.	0.3590E-01	353.6
269.9	3898.	9940.	0.3360E-01	334.0
339.3	1085.	98.80	0.7853	77.59
338.8	1804.	169.0	0.6067	102.5
338.8	2703.	98.80	1.221	120.6
352.6	1076.	28.10	1.150	32.31
352.1	1789.	107.0	0.4077	43.62
366.0	1775.	66.50	0.4342	28.57



TGA of E-A-R Division's EXCDAMP C-2003.

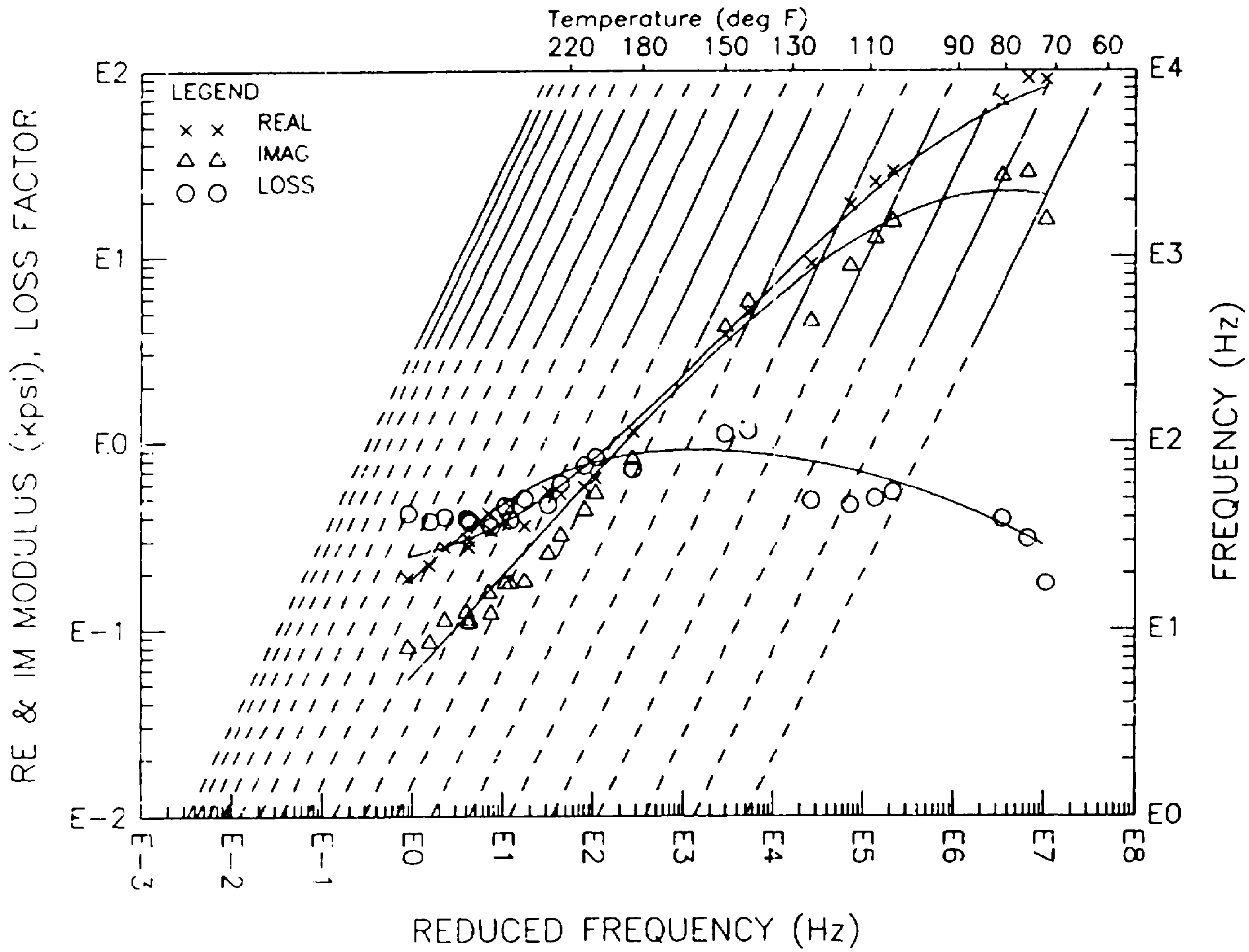
SOUNDCOAT DYAD 609 SHEAR

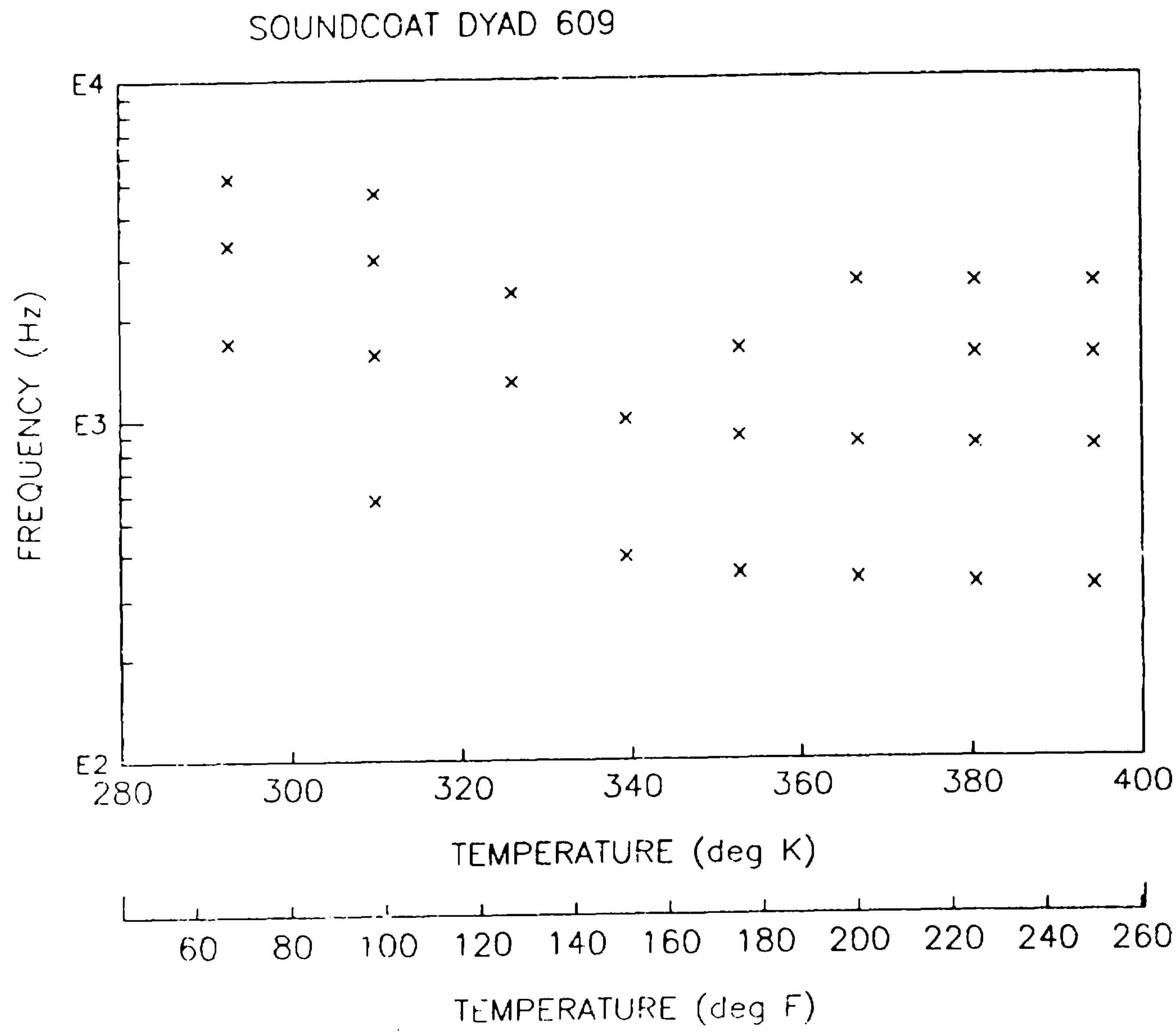
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.2812	0.6244	0.8920	0.6244	0.1791
MODULUS	MPA	530.4	0.0000E+00	14.72	3.312	1.652
	PSI	0.7692E+05	0.0000E+00	2134.	480.4	239.6
10.HZ	DEG K		0.0000E+00	306.0	325.0	
	DEG C		-293.1	12.85	31.85	
	DEG F		-495.7	55.13	89.33	
100.HZ	DEG K		292.0	317.0	340.0	
	DEG C		-1.150	23.85	46.85	
	DEG F		29.93	74.93	116.3	
1000.HZ	DEG K		303.0	331.0	359.0	
	DEG C		9.850	37.85	65.85	
	DEG F		49.73	100.1	150.5	

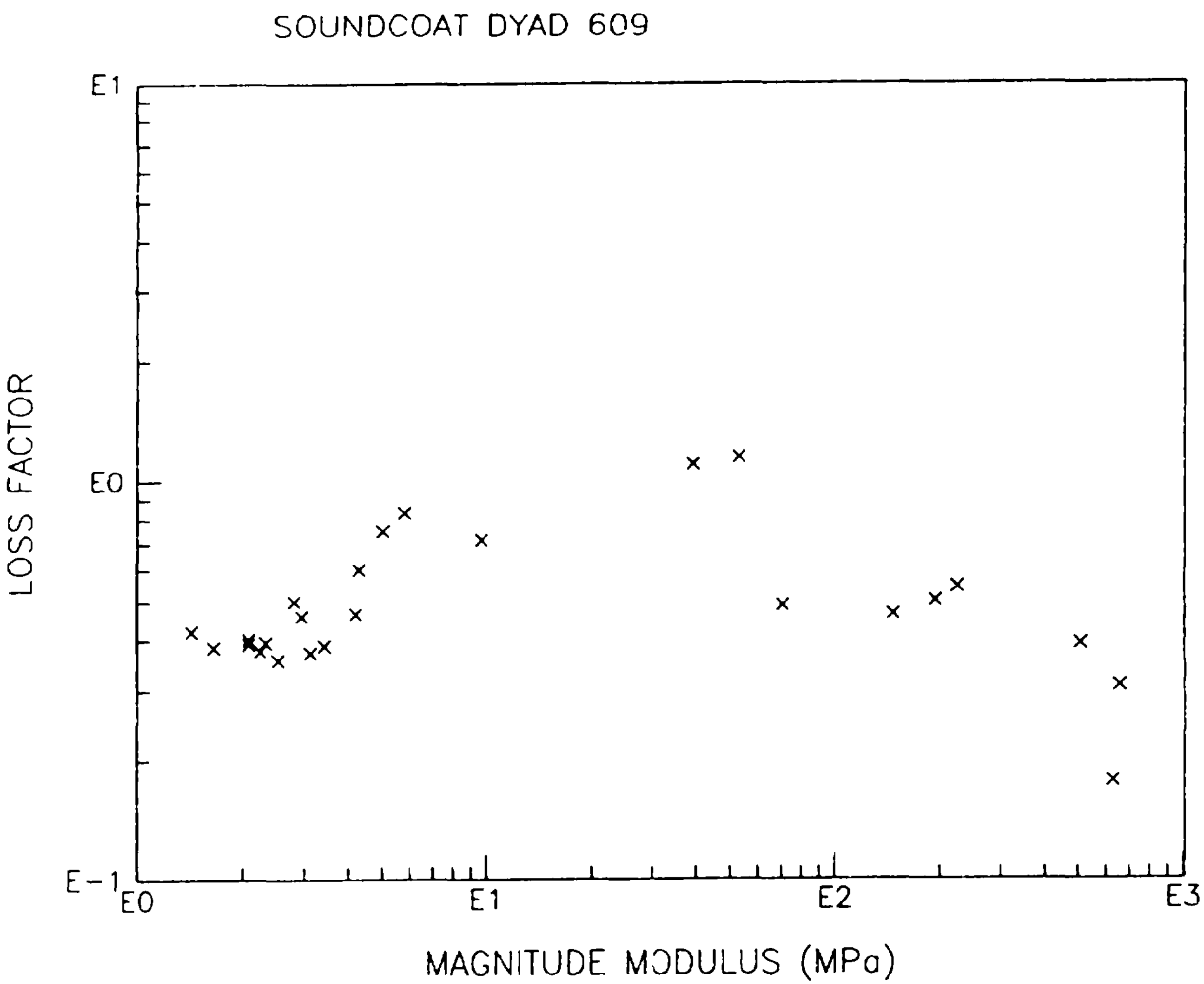

SOUNDCOAT DYAD 609
SHEAR
Temperature (deg K)
380 360 345 330 320 310 300 290
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
E3
E2
E1
E0
E-1
E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8
E4
E3
E2
E1
E0
RE & IM MODULUS (MPa), LOSS FACTOR
REDUCED FREQUENCY (Hz)
FREQUENCY (Hz)

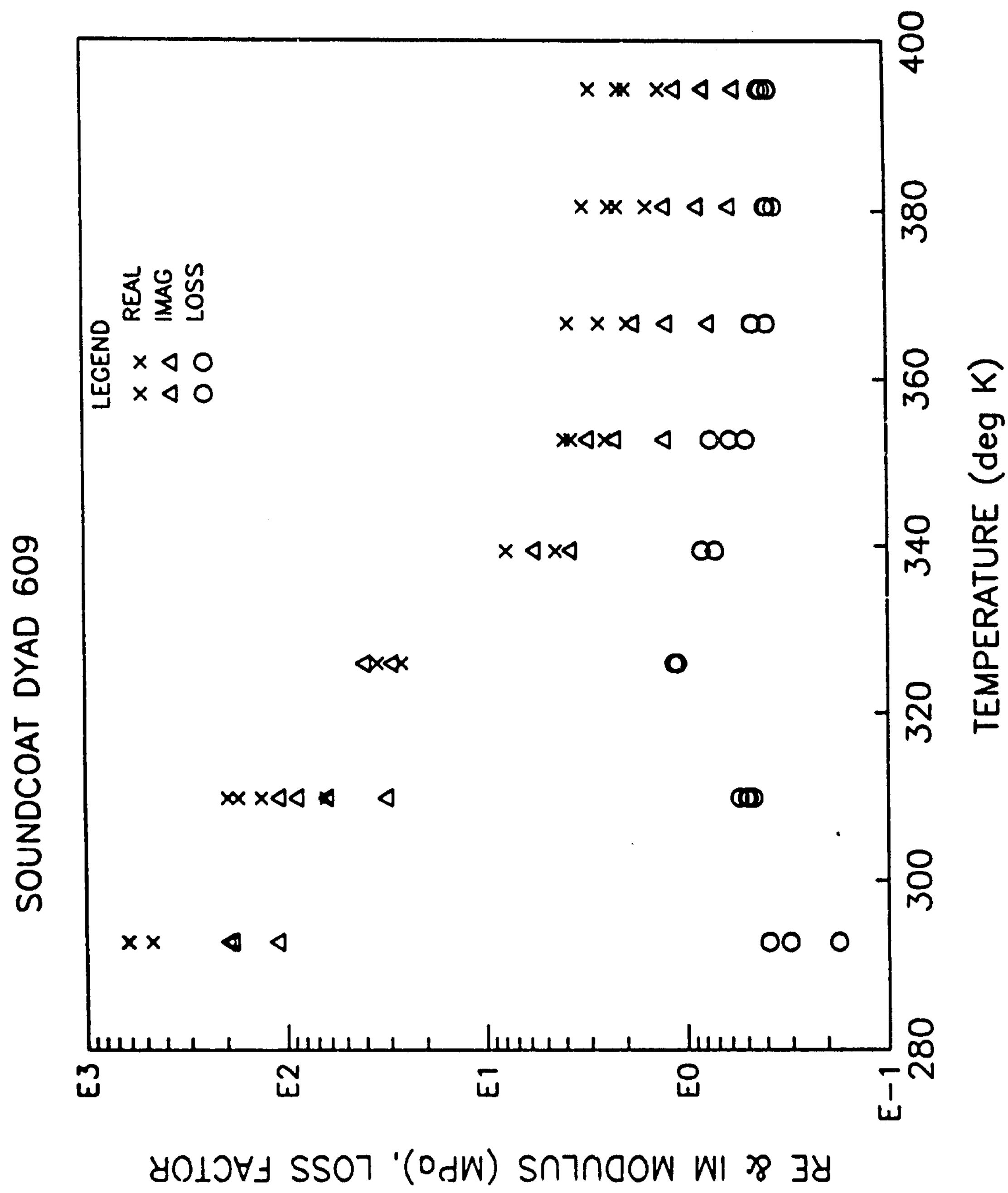
SOUNDCOAT DYAD 609

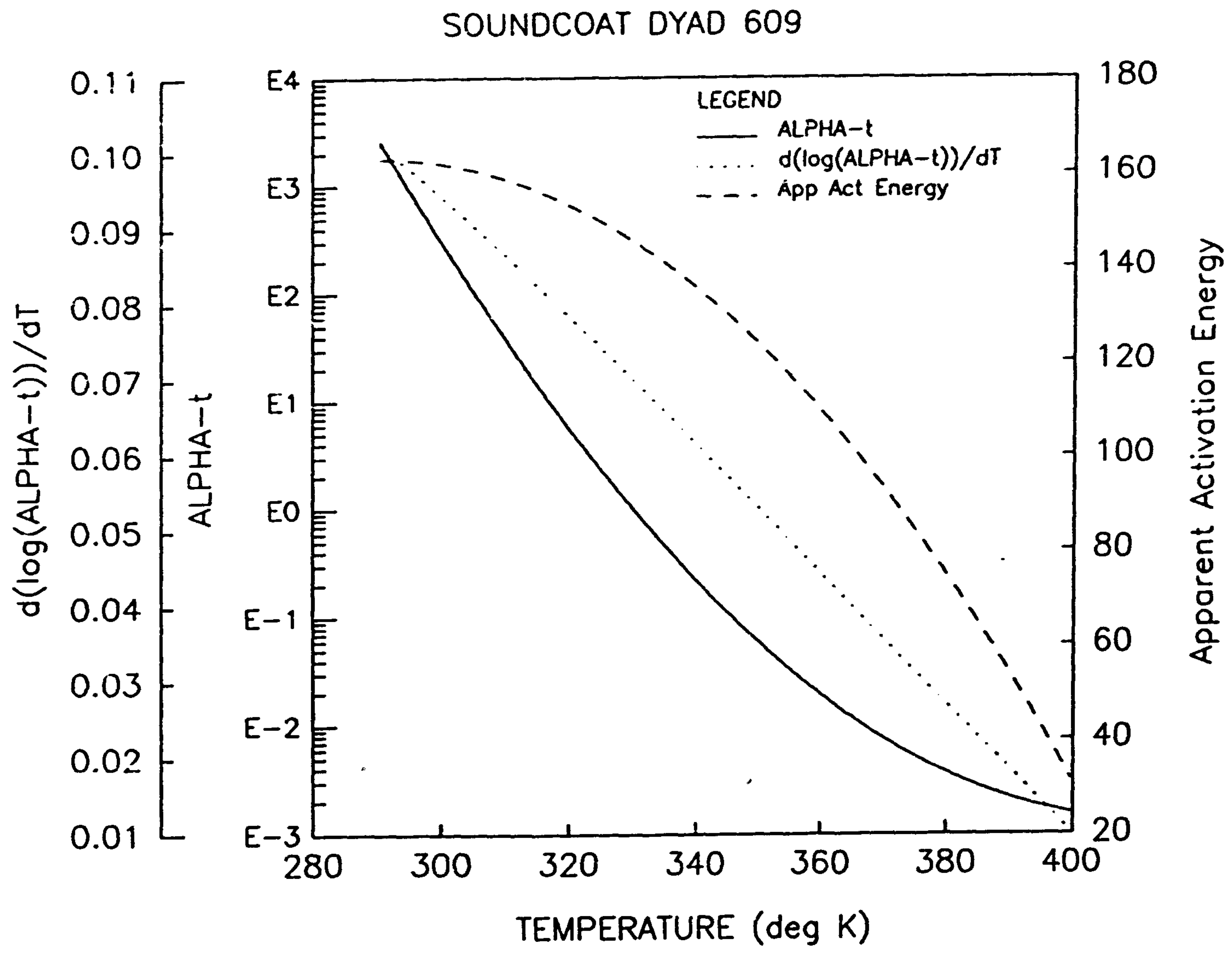
SHEAR




SOUNDCOAT DYAD 609
E4
E3
E2
FREQUENCY (Hz)
280
300
320
340
360
380
400
TEMPERATURE (deg K)
60
80
100
120
140
160
180
200
220
240
260
TEMPERATURE (deg F)


SOUNDCOAT DYAD 609
E1
E0
E-1
LOSS FACTOR
E0
E1
E2
E3
MAGNITUDE MODULUS (MPa)


SOUNDCOAT DYAD 609
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR
280
300
320
340
360
380
400
E−1
E0
E1
E2
E3



SOUNDCOAT DYAD 609
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
ALPHA-t
E4
E3
E2
E1
E0
E-1
E-2
E-3
280
300
320
340
360
380
400
TEMPERATURE (deg K)
Apparent Activation Energy
180
160
140
120
100
80
60
40
20

SOUNDCOAT DYAD 609 SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	330.0	290.0	400.0	0.7000E-01	0.1016	0.1000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	1.400	1000.	0.6800E+06	0.5600	1.400	0.3000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
292.6	3271.	623.7	0.3076	191.9
292.6	5186.	615.2	0.1765	108.6
309.8	576.0	62.99	0.4890	30.80
309.8	1568.	131.9	0.4639	61.19
309.8	2963.	172.0	0.5029	86.50
309.8	4653.	195.9	0.5424	106.3
325.9	1300.	26.12	1.100	28.73
325.9	2367.	34.54	1.145	39.55
339.3	391.1	4.415	0.8329	3.677
339.3	1001.	7.798	0.7136	5.565
352.6	351.1	2.489	0.5006	1.246
352.6	886.1	3.666	0.6005	2.201
352.6	1620.	3.991	0.7501	2.994
366.5	849.1	2.653	0.4589	1.217
366.5	2536.	3.785	0.4655	1.762
380.4	326.1	1.531	0.3836	0.5873
380.4	828.1	2.144	0.3951	0.8471
380.4	1546.	2.350	0.3581	0.8415
380.4	2502.	3.162	0.3871	1.224
394 3	319.1	1.307	0.4209	0.5501
394.3	817.0	1.920	0.4024	0.7726
394.3	1530.	2.080	0.3769	0.7840
394.3	2482.	2.895	0.3733	1.081
292.6	1695.	468.9	0.3911	183.4
366.5	337.1	1.926	0.3907	0.7525

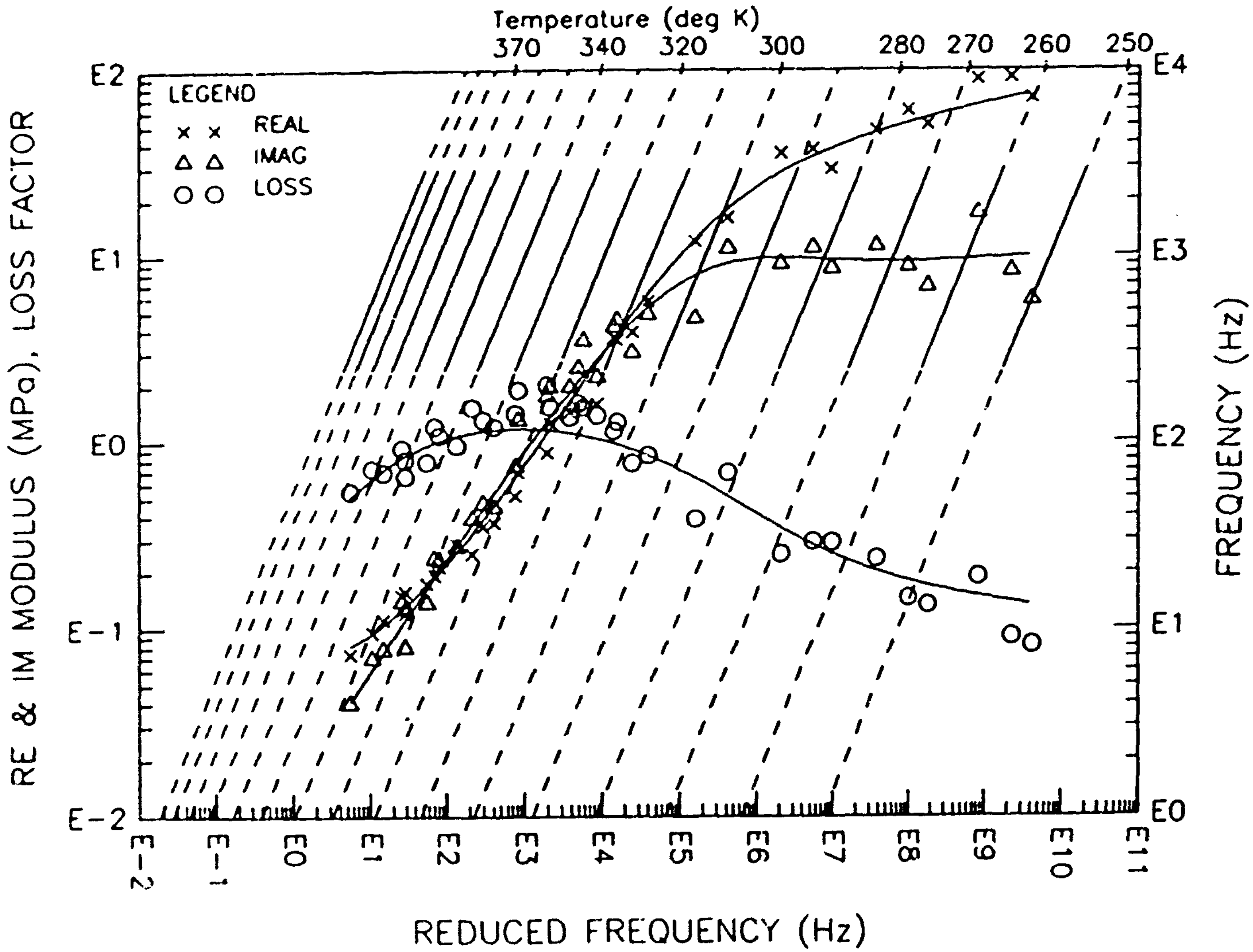
3M ISD 110

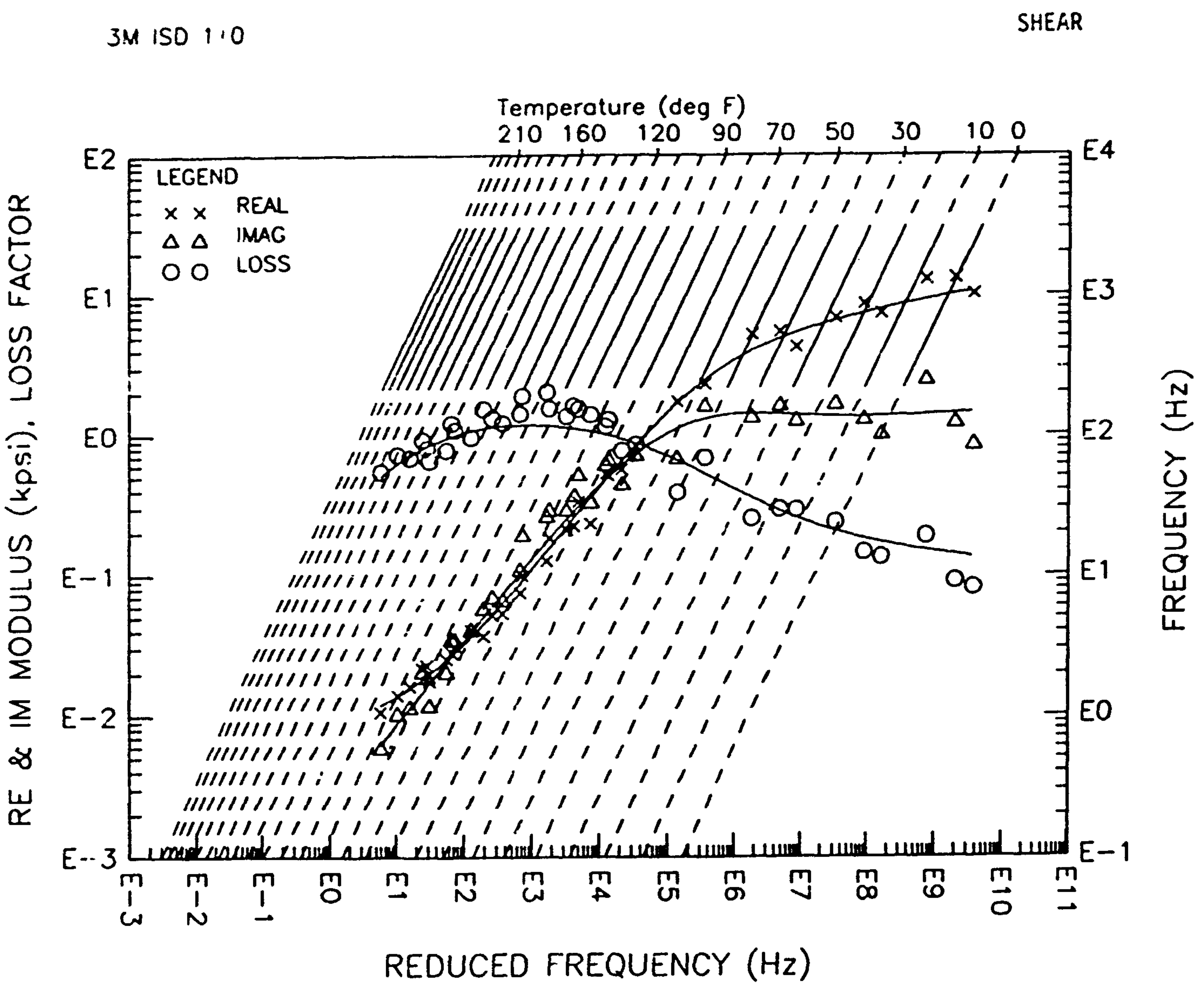
SHEAR

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTR. LOSS FACTOR		0.1344	0.8249	1.178	0.8249	0.5062
MODULUS	MPA	73.98	7.394	0.6854	0.1315	0.8102E-01
	PSI	0.1073E+05	1072.	99.41	19.07	11.75
10. HZ	DEG K		282.3	306.0	331.0	
	DEG C		-11.15	12.85	37.85	
	DEG F		11.93	55.13	100.1	
100. HZ	DEG K		295.0	322.0	354.0	
	DEG C		1.850	28.85	60.85	
	DEG F		35.33	83.93	141.5	
1000. HZ	DEG K		309.0	342.0	390.0	
	DEG C		15.85	48.85	96.85	
	DEG F		60.53	119.9	206.3	

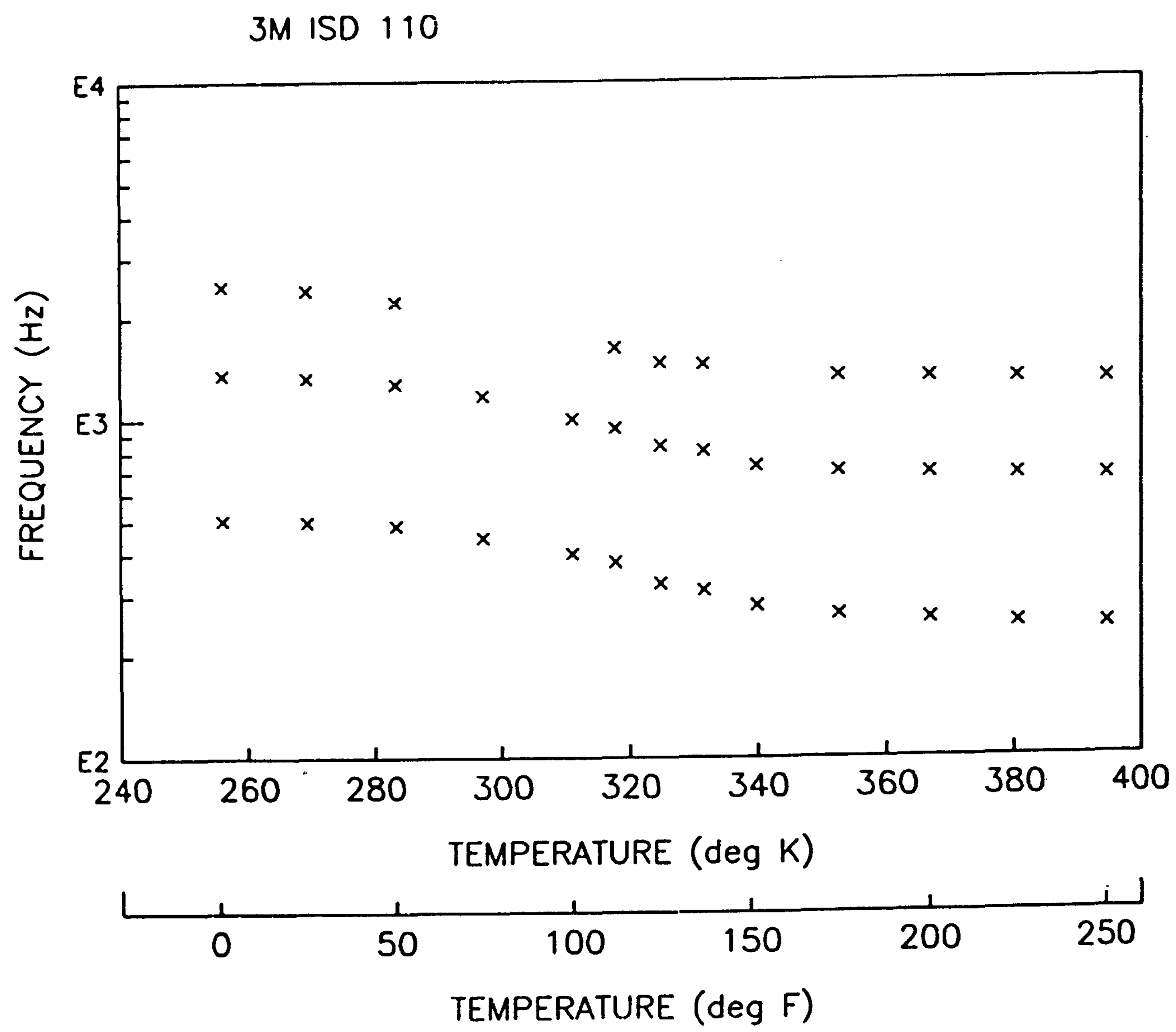
3M ISD 110

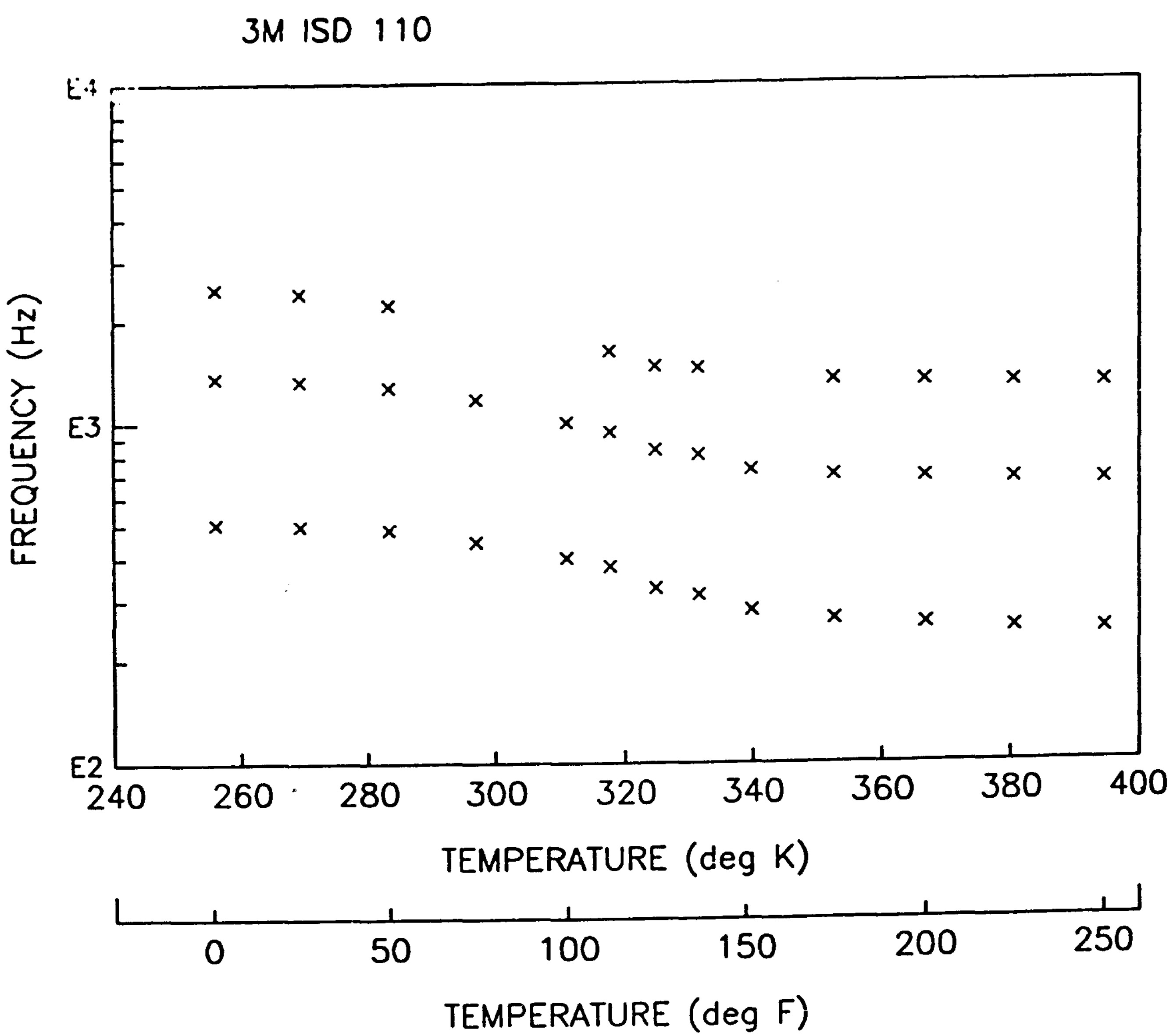
SHEAR



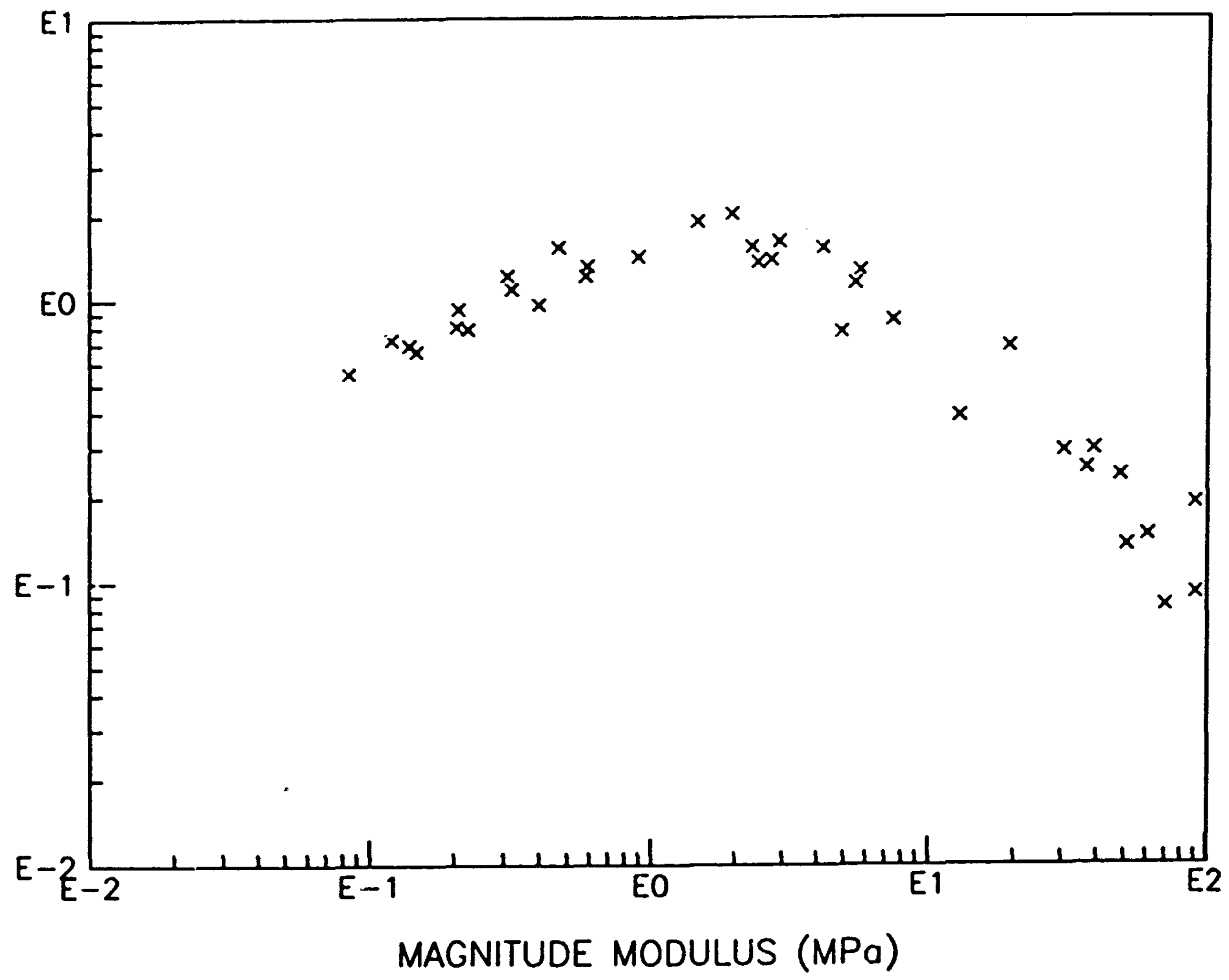


3M ISD 110
SHEAR
Temperature (deg F)
210 160 120 90 70 50 30 10 0
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E2
E1
E0
E−1
E−2
E−3
FREQUENCY (Hz)
E4
E3
E2
E1
E0
E−1
E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11
REDUCED FREQUENCY (Hz)

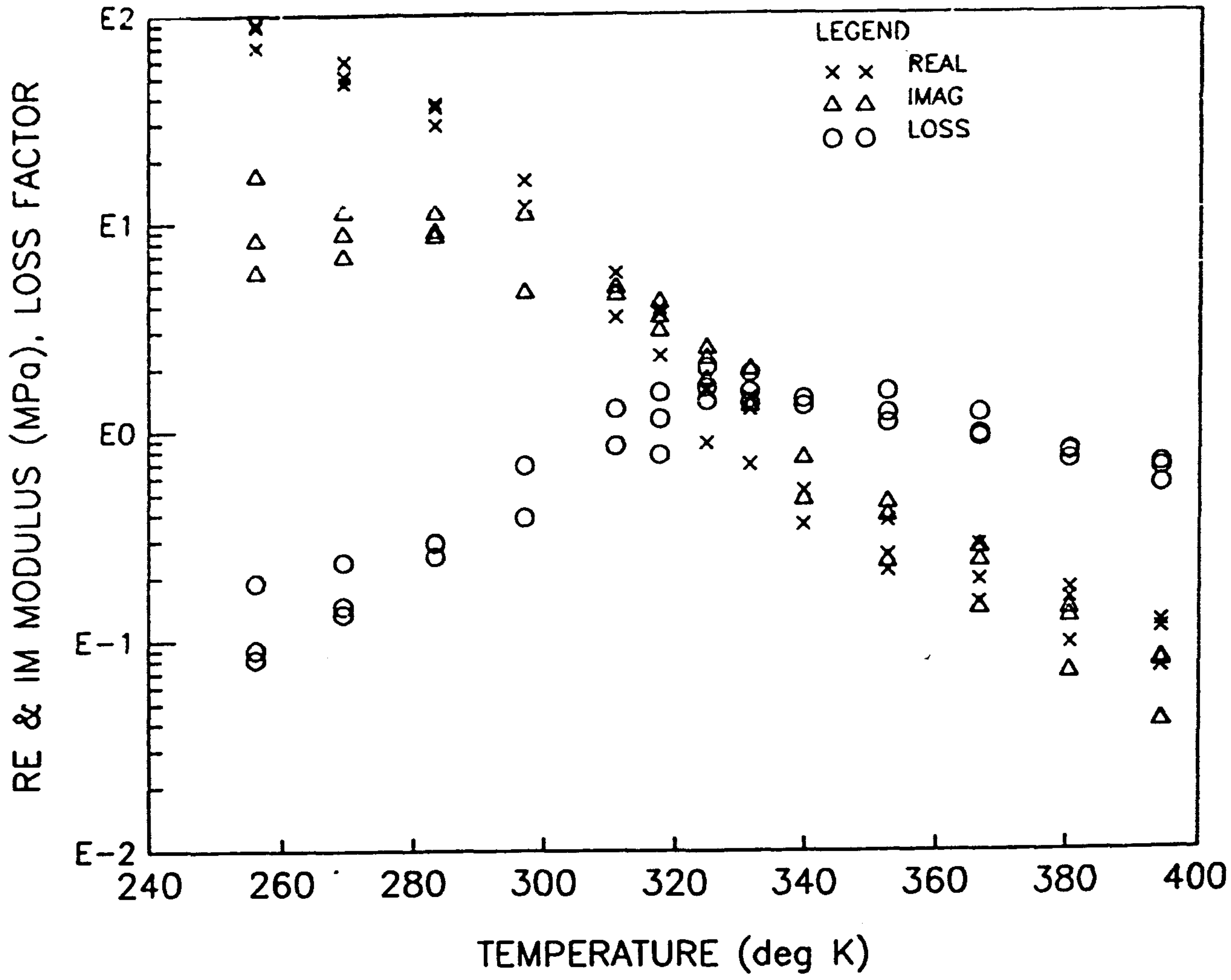

3M ISD 110
FREQUENCY (Hz)
E4
E3
E2
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)
0
50
100
150
200
250
TEMPERATURE (deg F)

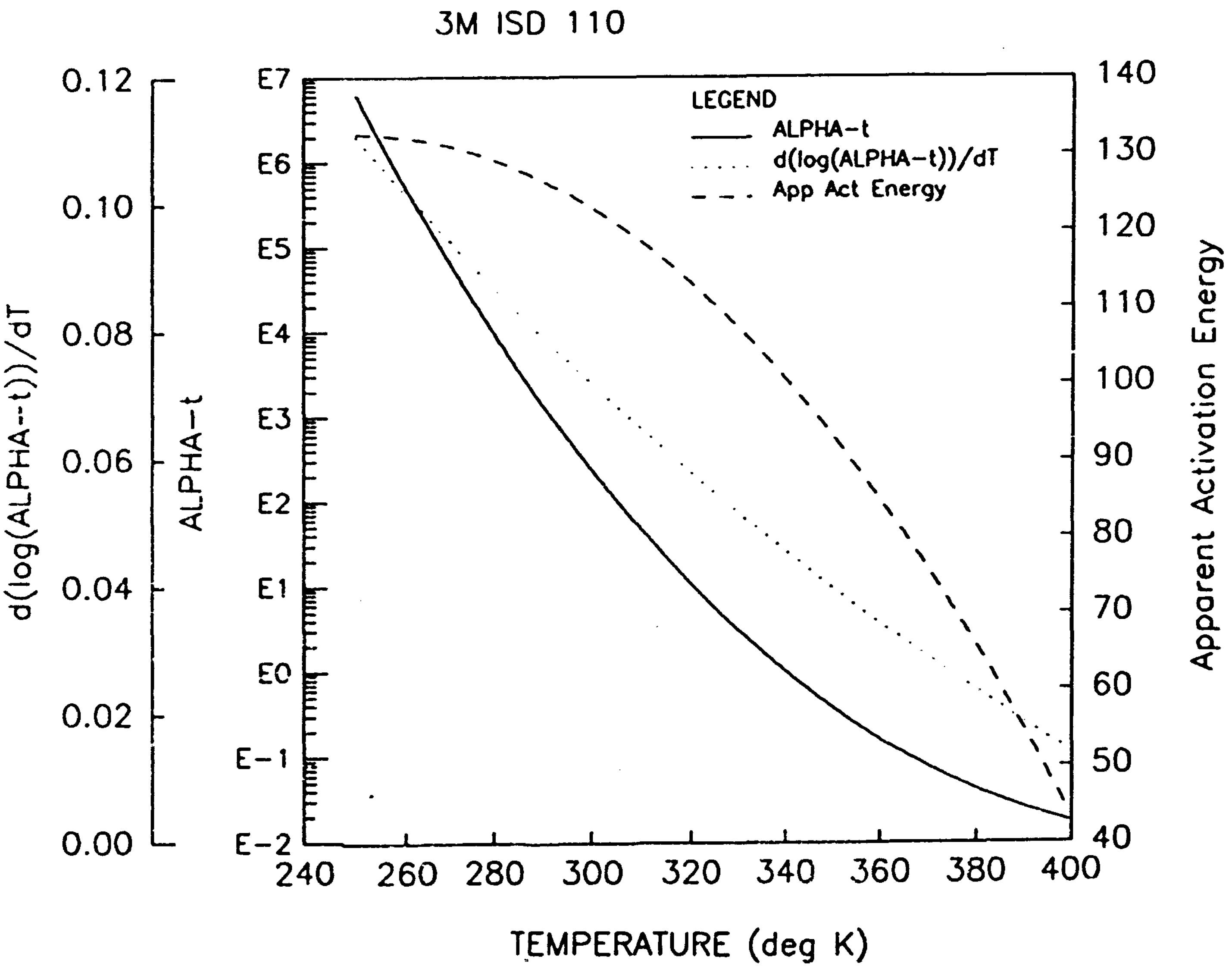

3M ISD 110
FREQUENCY (Hz)
E4
E3
E2
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)
0
50
100
150
200
250
TEMPERATURE (deg F)

3M ISD 110



3M ISD 110


LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E2
E1
E0
E−1
E−2
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)


3M ISD 110
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA--t))/dT
0.12
0.10
0.08
0.06
0.04
0.02
0.00
ALPHA-t
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)
140
130
120
110
100
90
80
70
60
50
40
Apparent Activation Energy

3M ISD 110 SHEAR

ALFA-T MODEL

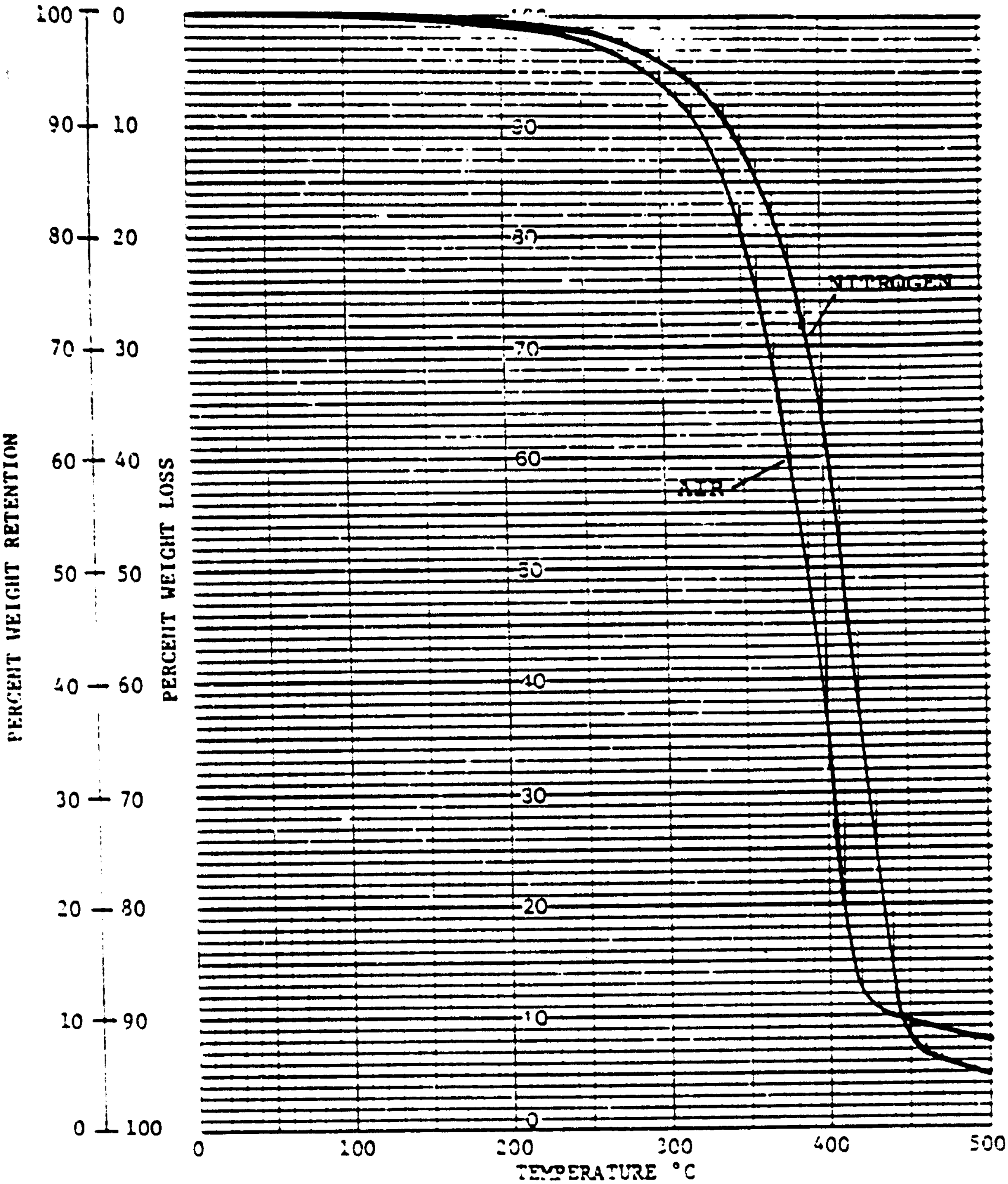
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	340.0	250.0	400.0	0.4553E-01	0.1112	0.1416E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.5168E-01	200.0	0.4370E+07	0.6075	4.132	0.1312

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
255.9	505.6	88.19	0.1893	16.69
255.9	1359.	90.32	0.9049E-01	8.173
255.9	2489.	70.05	0.8170E-01	5.723
269.3	496.8	47.12	0.2372	11.18
269.3	1330.	59.82	0.1458	8.722
269.3	2413.	50.61	0.1342	6.792
283.2	485.2	35.72	0.2519	8.998
283.2	1272.	37.47	0.2935	11.00
283.2	2235.	29.31	0.2909	8.526
297.0	445.9	11.91	0.3860	4.597
297.0	1172.	15.91	0.6833	10.87
310.9	399.9	3.525	1.274	4.491
310.9	1001.	5.717	0.8461	4.837
324.8	325.6	0.8722	2.020	1.762
324.8	829.7	1.546	1.609	2.488
324.8	1468.	1.602	1.388	2.224
339.8	279.3	0.3565	1.316	0.4692
339.8	723.1	0.5176	1.421	0.7355
317.6	377.2	2.293	1.529	3.506
317.6	938.9	3.618	1.142	4.132
317.6	1620.	3.898	0.7697	3.000
331.5	311.4	0.6895	1.898	1.309
331.5	801.6	1.264	1.542	1.949
331.5	1450.	1.448	1.359	1.968
352.6	263.9	0.2161	1.088	0.2351
352.6	696.6	0.2544	1.537	0.3910
352.6	1335.	0.3710	1.211	0.4493
366.5	255.4	0.1516	0.9280	0.1407
366.5	687.0	0.1953	1.217	0.2377
366.5	1321.	0.2863	0.9632	0.2758
380.4	247.5	0.9646E-01	0.7234	0.6978E-01
380.4	674.8	0.1588	0.8036	0.1276
380.4	1304.	0.1764	0.7854	0.1385
394.3	243.6	0.7343E-01	0.5490	0.4031E-01
394.3	666.7	0.1129	0.6897	0.7787E-01
394.3	1292.	0.1218	0.6563	0.7994E-01

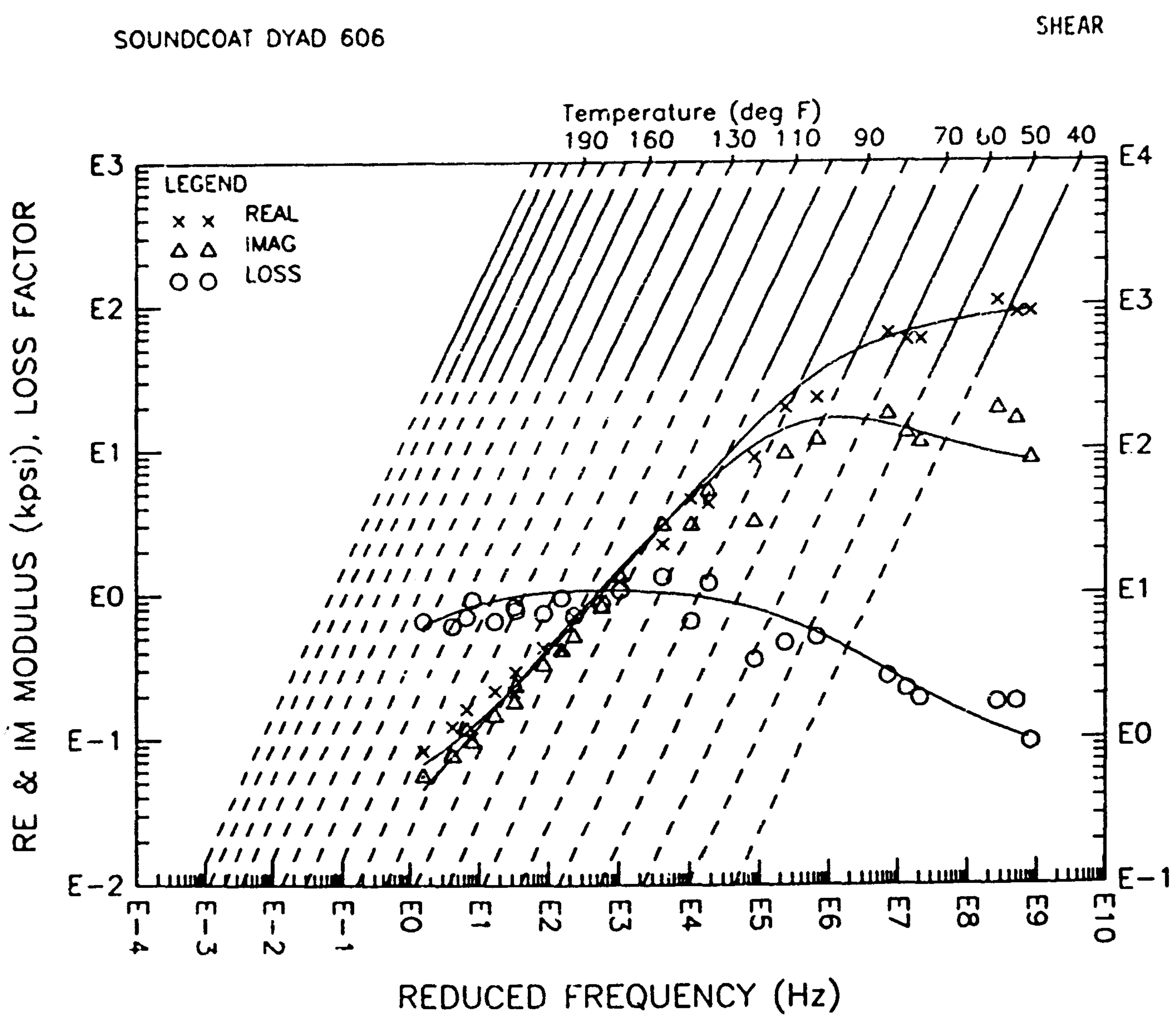


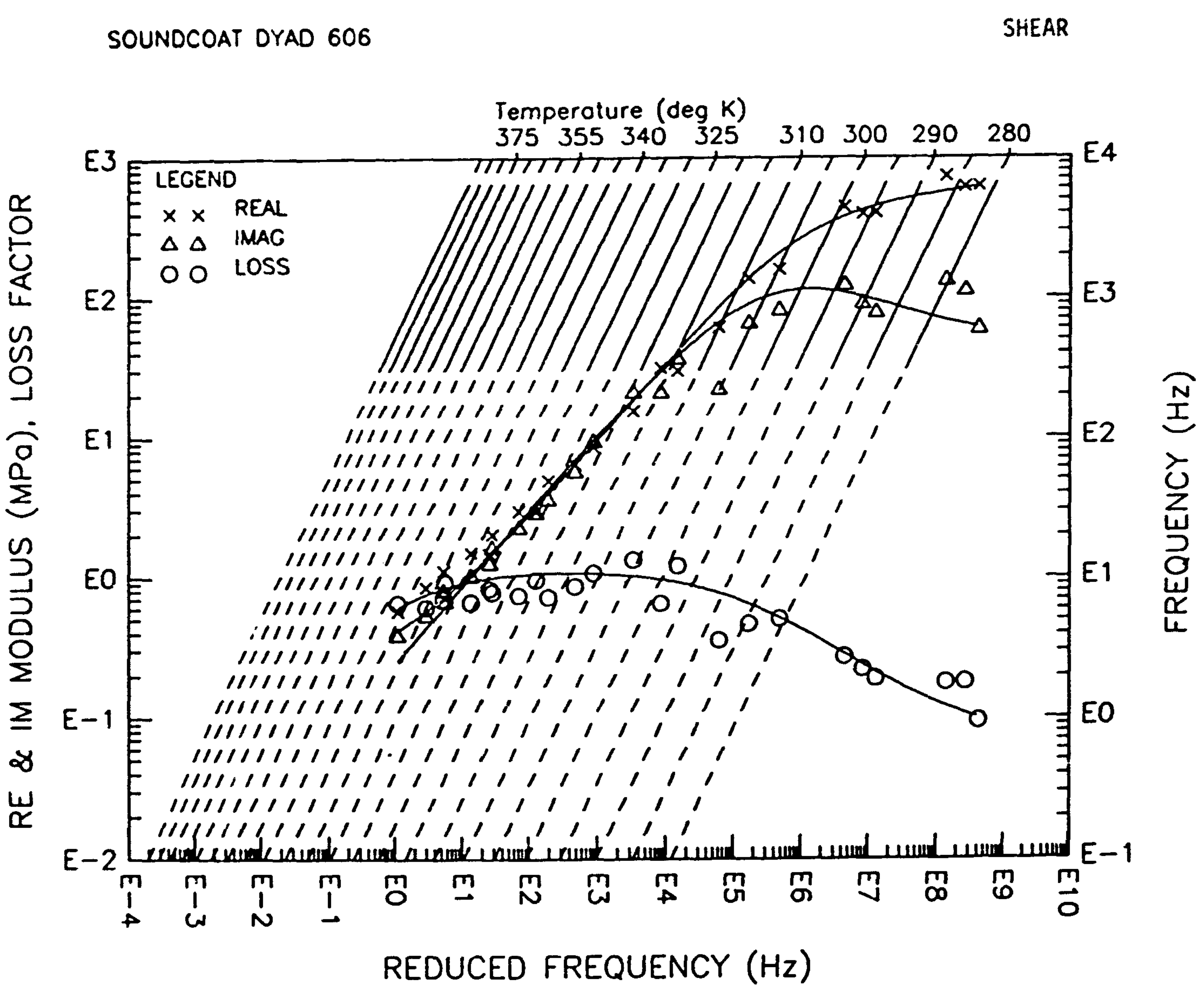
TGA of 3M Company's ISD 110.

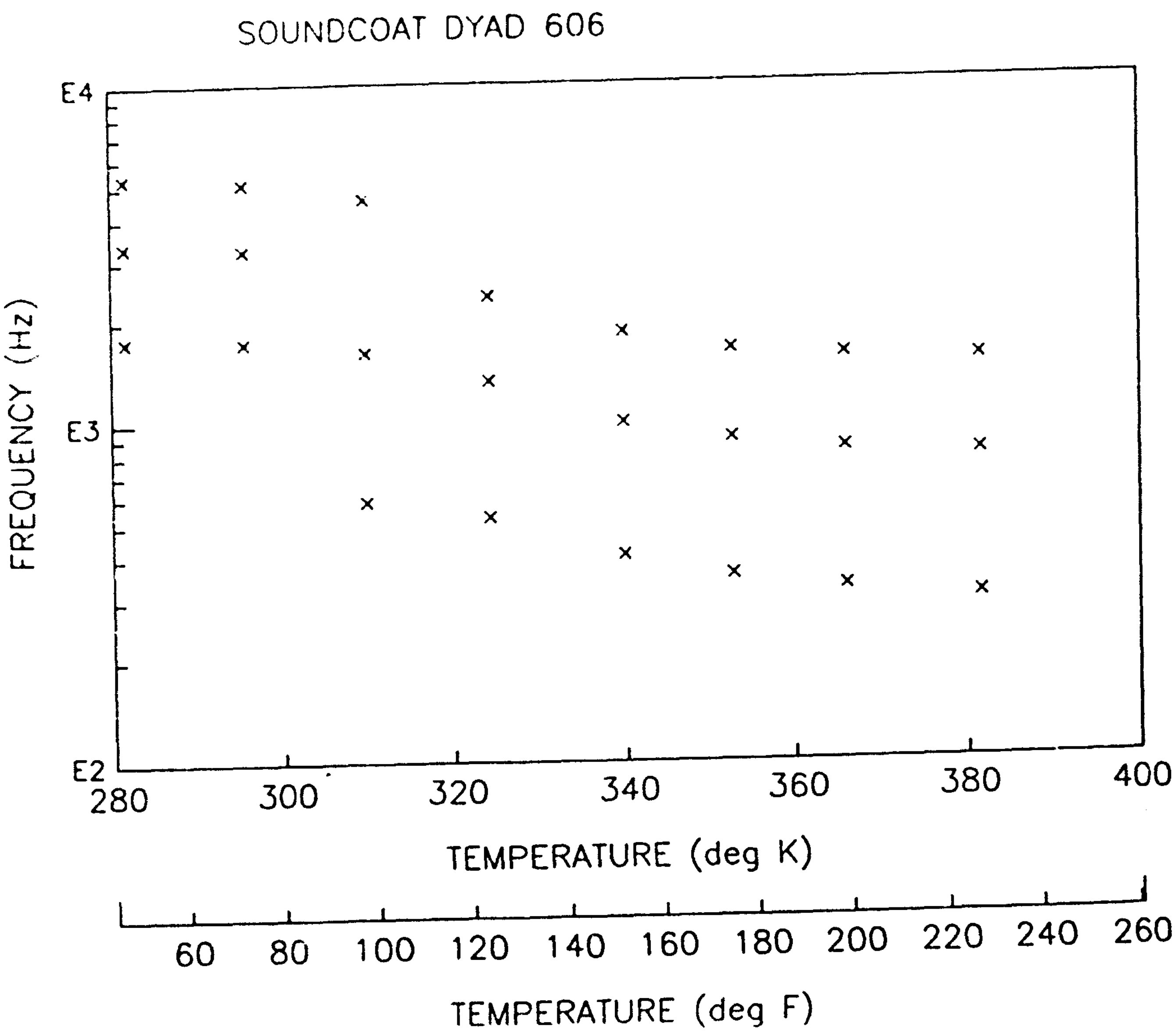
SOUNDCOAT DYAD 606

SHEAR

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.9958E-01	0.7563	1.080	0.7563	0.6140
MODULUS	MPA	609.9	103.6	5.657	0.5841	0.4219
	PSI	0.8846E+05	0.1502E+05	820.4	84.71	61.19
10.HZ	DEG K		290.0	315.0	343.0	
	DEG C		-3.150	21.85	49.85	
	DEG F		26.33	71.33	121.7	
100.HZ	DEG K		300.0	328.0	361.0	
	DEG C		6.850	34.85	67.85	
	DEG F		44.33	94.73	154.1	
1000.HZ	DEG K		311.0	342.0	384.0	
	DEG C		17.85	48.85	90.85	
	DEG F		64.13	119.9	195.5	

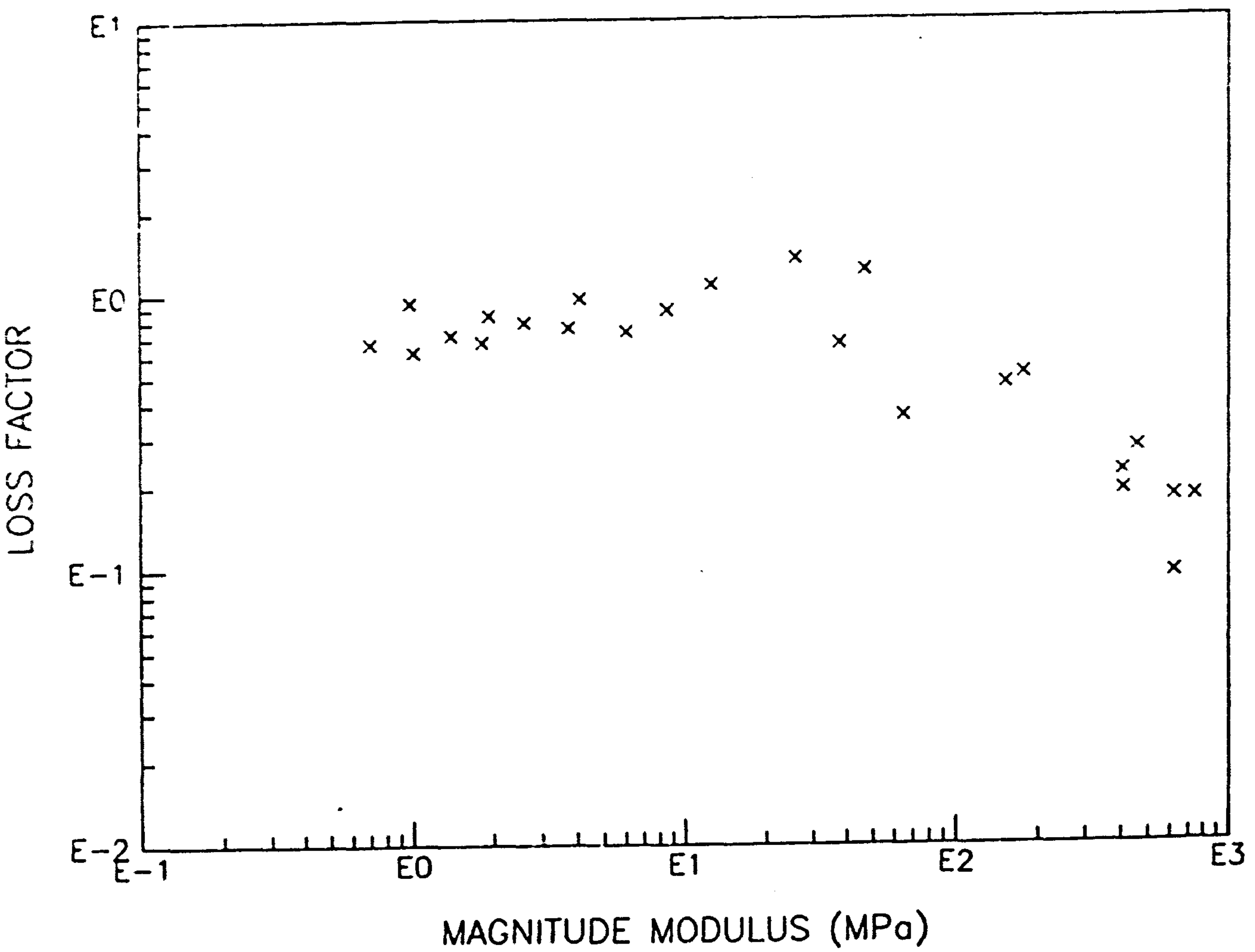

SOUNDCOAT DYAD 606
SHEAR
Temperature (deg F)
190 160 130 110 90 70 60 50 40
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E4 E3 E2 E1 E0 E−1
E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10
REDUCED FREQUENCY (Hz)

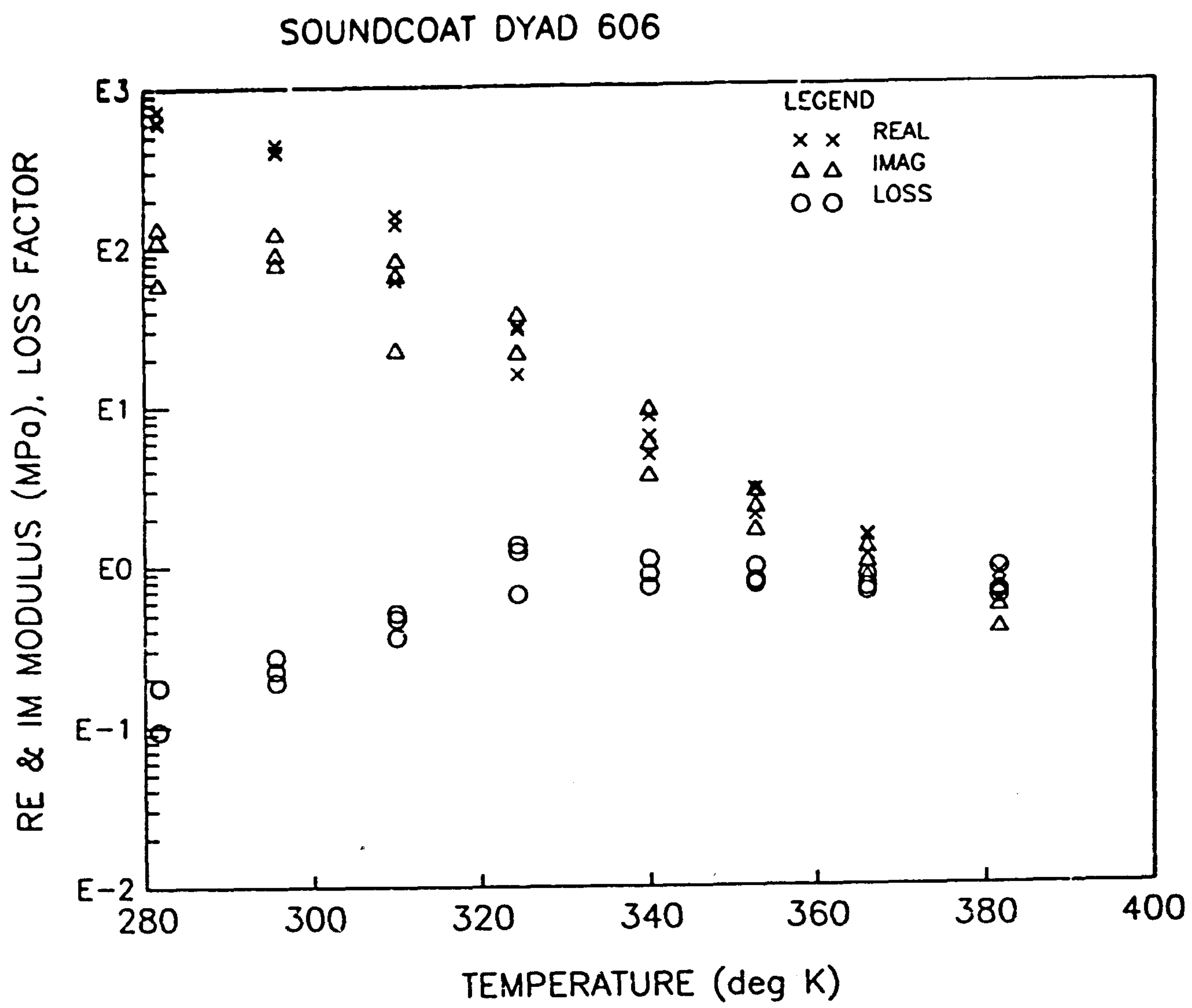

SOUNDCOAT DYAD 606
SHEAR
Temperature (deg K)
375 355 340 325 310 300 290 280
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
E3
E2
E1
E0
E−1
E−2
E4
E3
E2
E1
E0
E−1
E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)



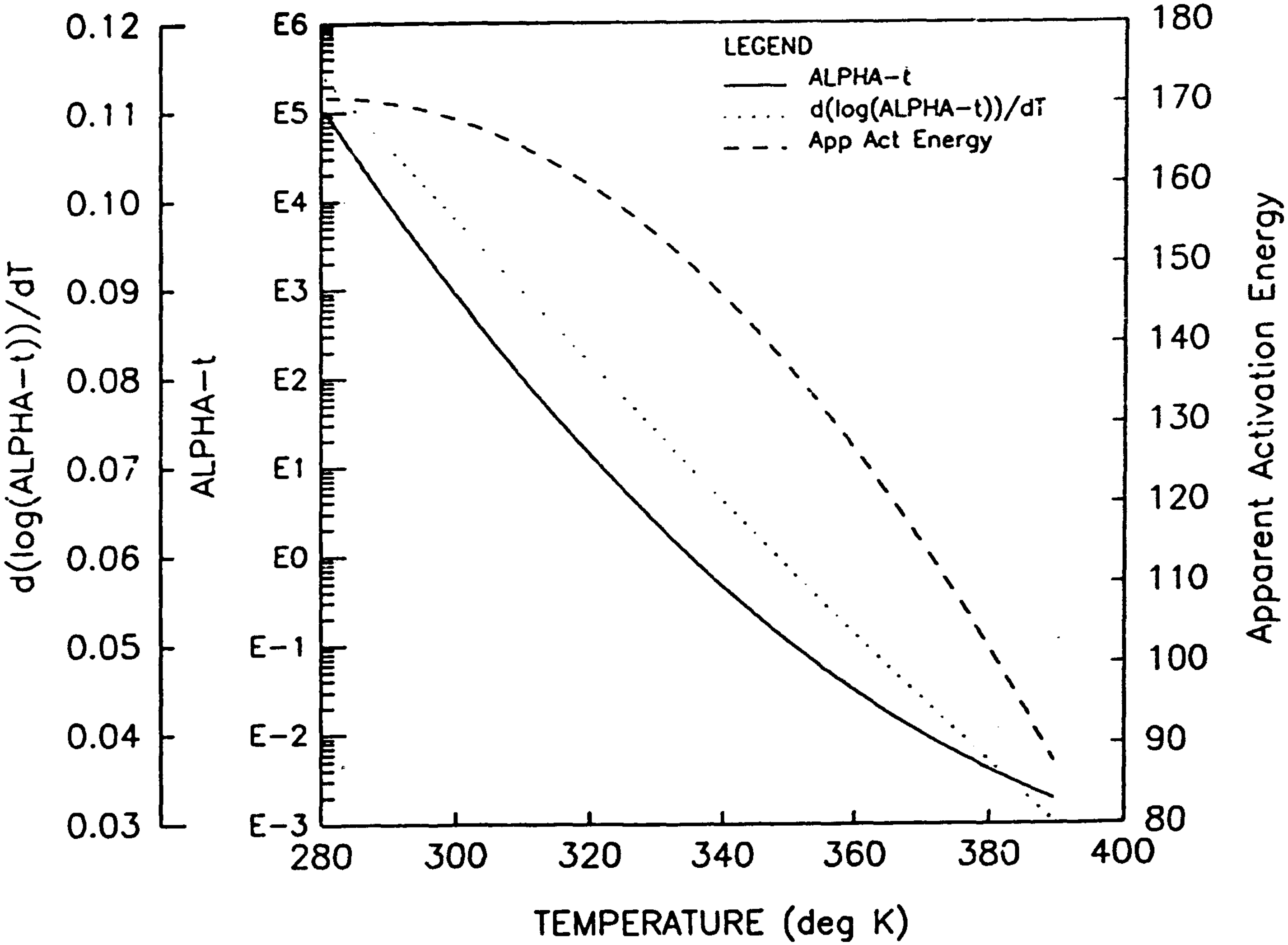
SOUNDCOAT DYAD 606
FREQUENCY (Hz)
E4
E3
E2
280
300
320
340
360
380
400
TEMPERATURE (deg K)
60
80
100
120
140
160
180
200
220
240
260
TEMPERATURE (deg F)

SOUNDCOAT DYAD 606




SOUNDCOAT DYAD 606
LEGEND
REAL
IMAG
LOSS
E3
E2
E1
E0
E−1
E−2
280
300
320
340
360
380
400
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR

SOUNDCOAT DYAD 606



SOUNDCOAT DYAD 606 SHEAR

ALFA-T MODEL

NALP	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	335 0	280.0	390.0	0.7000E-01	0.1142	0.3000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.2000	1200.	0.3000E+07	0.5500	1.500	0.1000

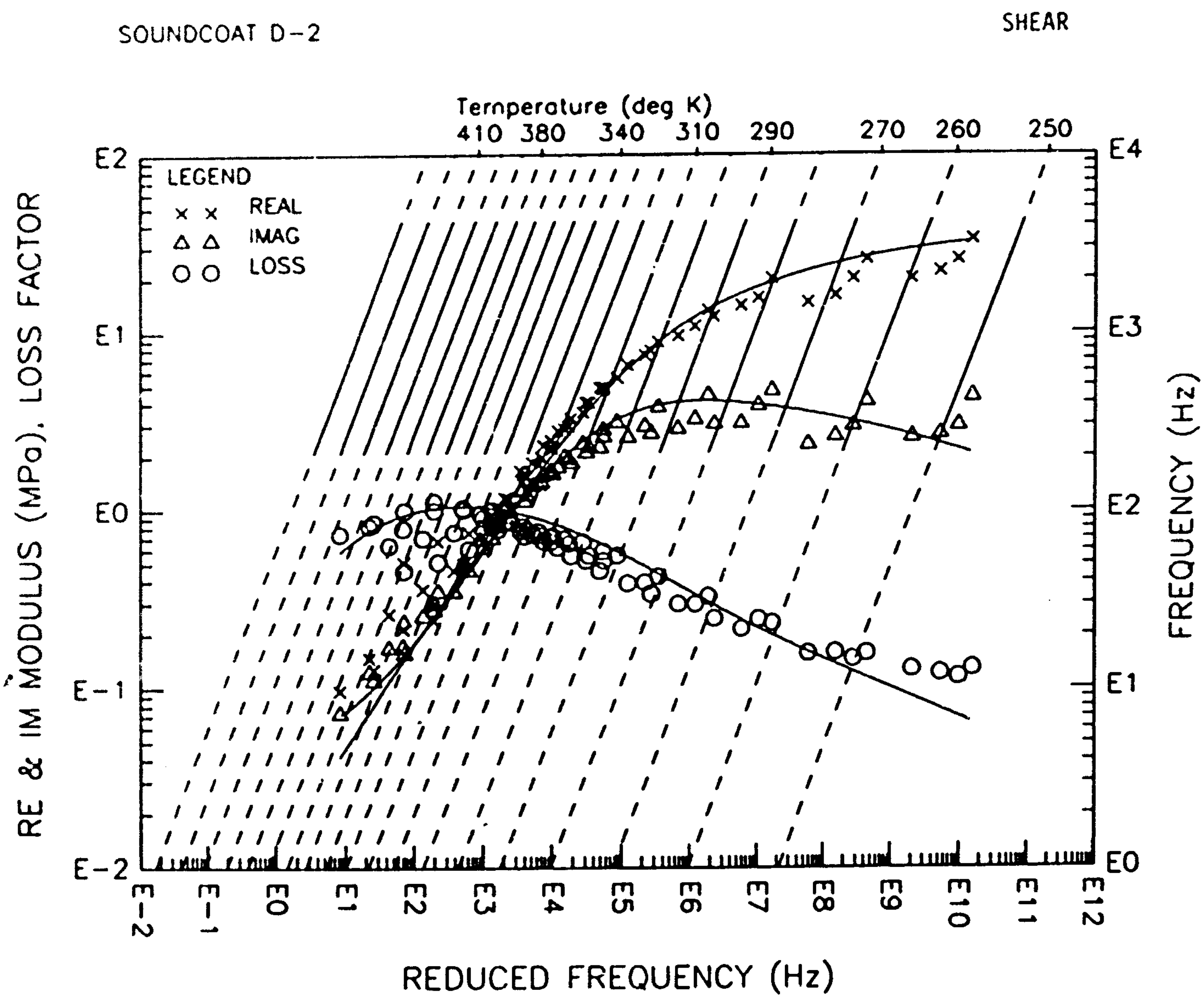
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
281.5	1761.	728.8	0.1783	129.9
281.5	3346.	610.1	0.1797	109.6
281.5	5311.	618.2	0.9461E-01	58.49
295.4	1728.	440.0	0.2724	119.9
295.4	3248.	394.9	0.2236	88.30
295.4	5106.	401.6	0.1902	76.38
309.8	584.0	60.56	0.3597	21.89
309.8	1610.	137.0	0.4699	64.38
309.8	4576.	157.8	0.5089	80.30
324.3	524.0	15.55	1.340	20.84
324.3	1323.	31.43	0.6604	20.75
324.3	2346.	29.77	1.216	36.20
339.8	404.1	4.905	0.7281	3.571
339.8	995.0	6.446	0.8744	5.636
339.8	1830.	8.564	1.081	9.258
352.6	887.1	2.985	0.7525	2.246
352.6	1626.	2.945	0.9647	2.841
352.6	352.1	2.037	0.7903	1 610
365.9	325.1	1.135	0.7085	0.8041
365.9	829.1	1.511	0.6677	1.009
365.9	1561.	1.405	0.8371	1.243
381.5	303.1	0.5812	0.6630	0.3853
381.5	797.1	0.8591	0.6158	0.5290
381.5	1518.	0.7157	0.9324	0.6673

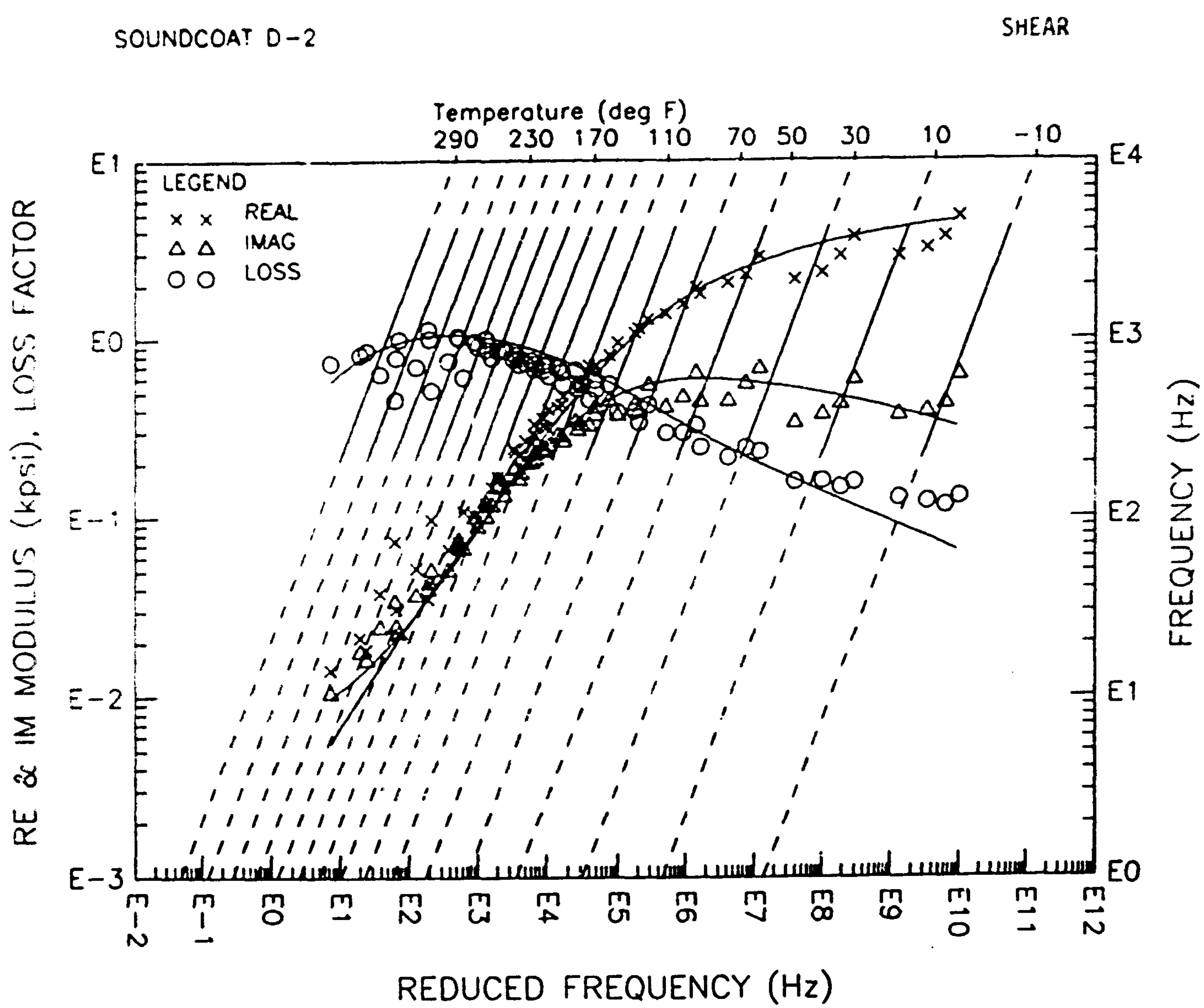
SOUNDCOAT D-2

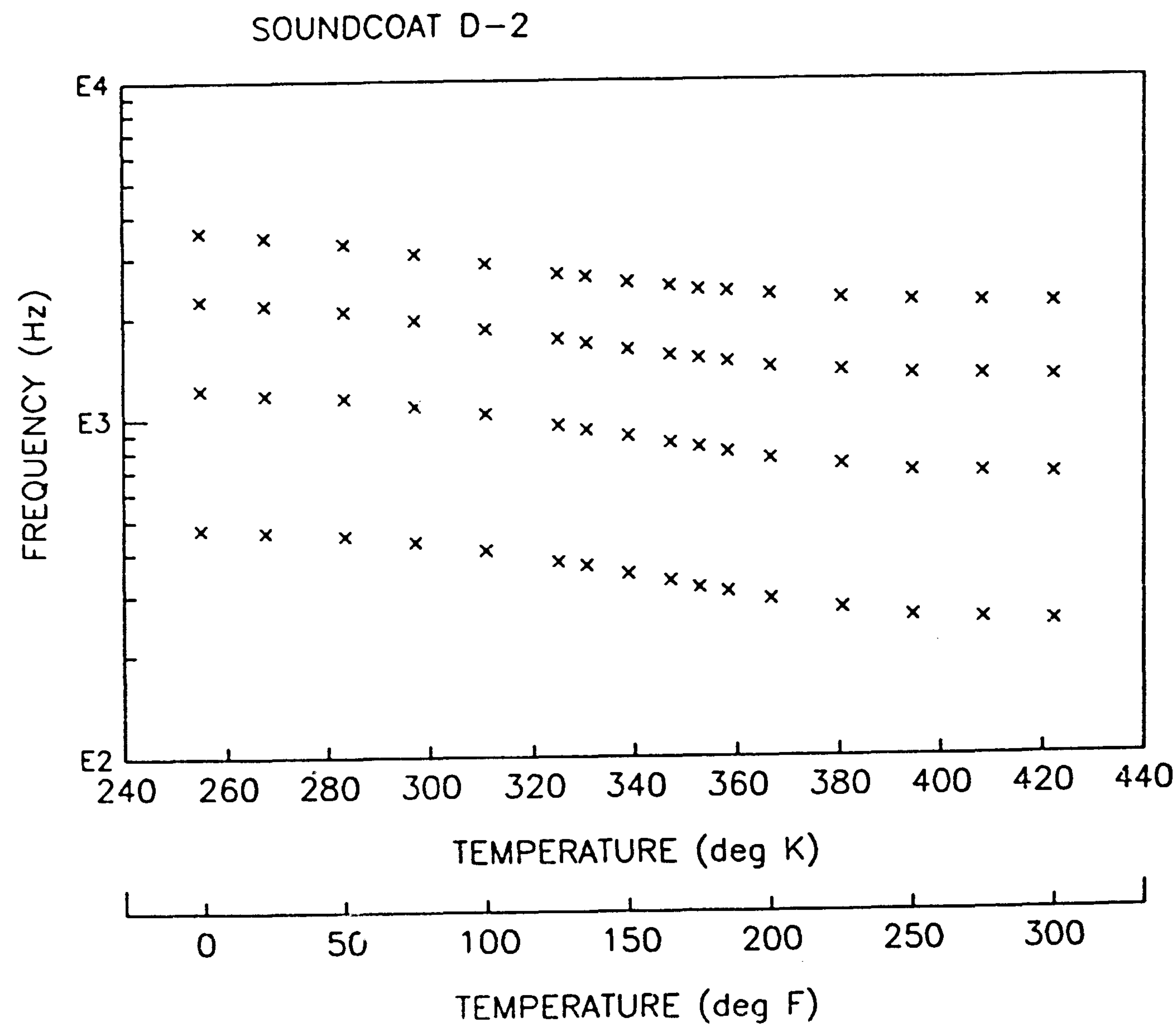
SHEAR

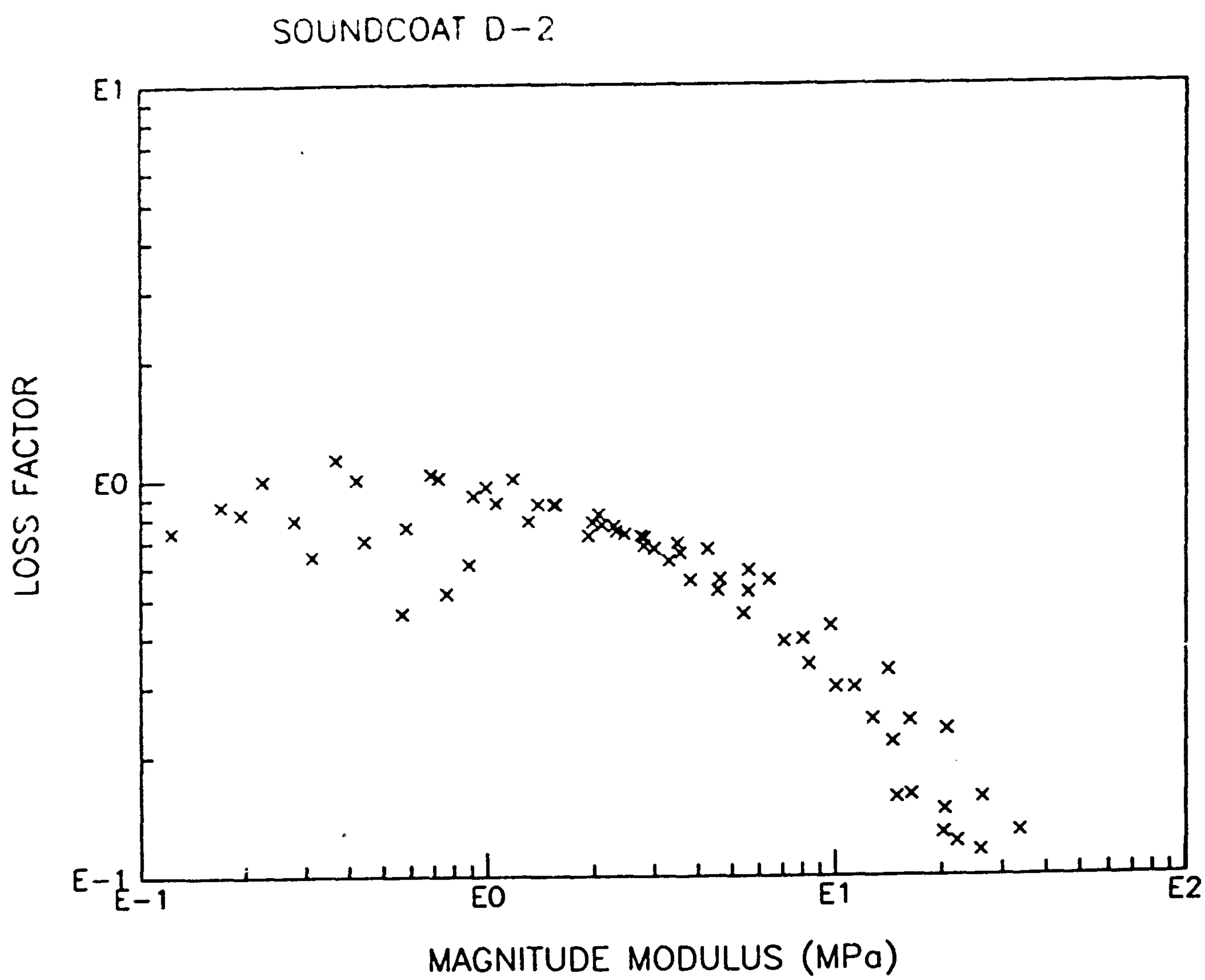
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.6430E-01	0.7401	1.057	0.7401	0.5856
MODULUS	MPA	32.11	3.342	0.4021	0.9217E-01	0.7130E-01
	PSI	4656.	484.8	58.32	13.37	10.34
10.HZ	DEG K		287.0	320.0	365.0	
	DEG C		-6.150	26.85	71.85	
	DEG F		20.93	80.33	161.3	
100.HZ	DEG K		304.0	351.0	400.0	
	DEG C		10.85	57.85	106.9	
	DEG F		51.53	136.1	224.3	
1000.HZ	DEG K		327.0	387.0	428.0	
	DEG C		33.85	93.85	134.9	
	DEG F		92.93	200.9	274.7	

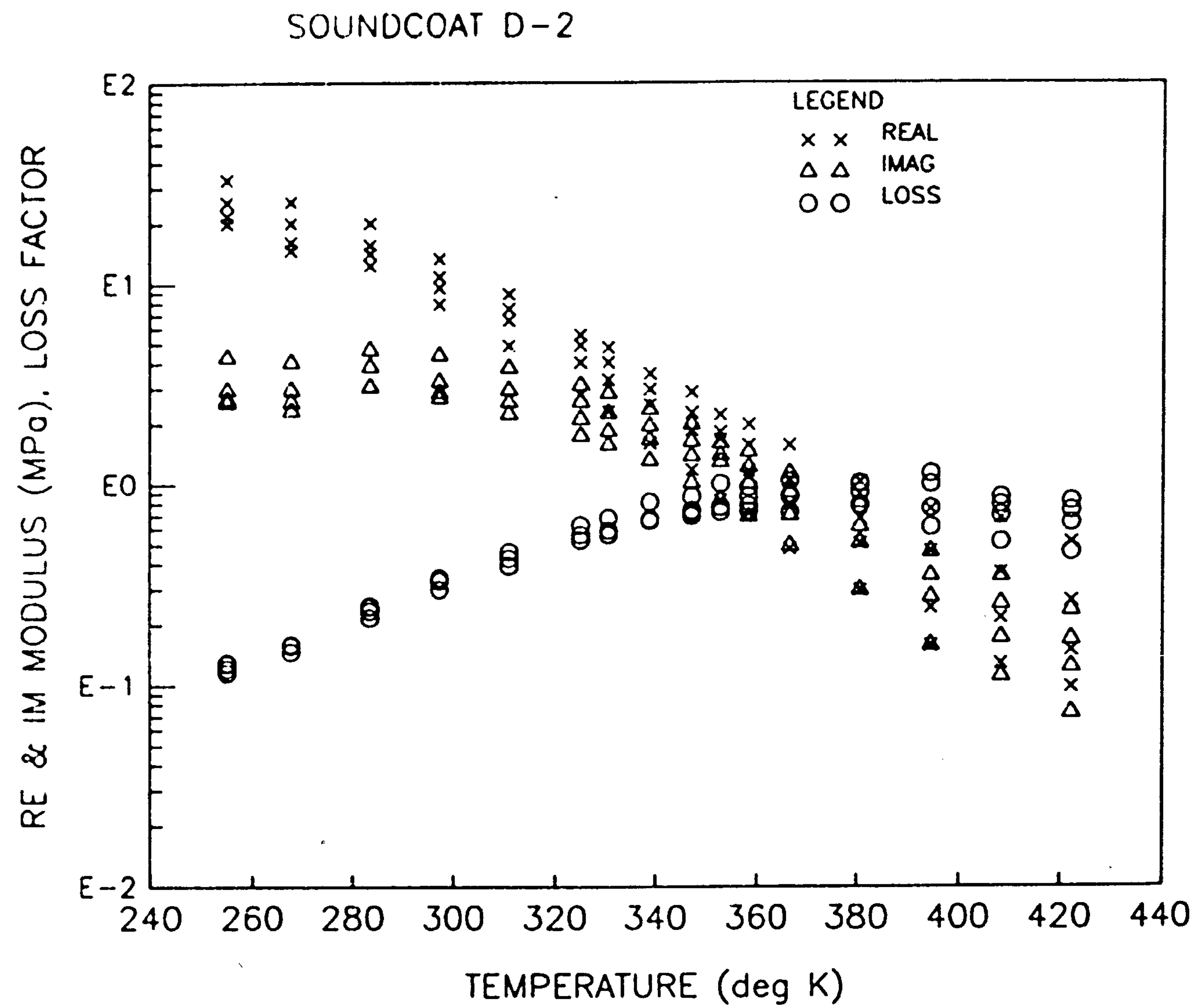


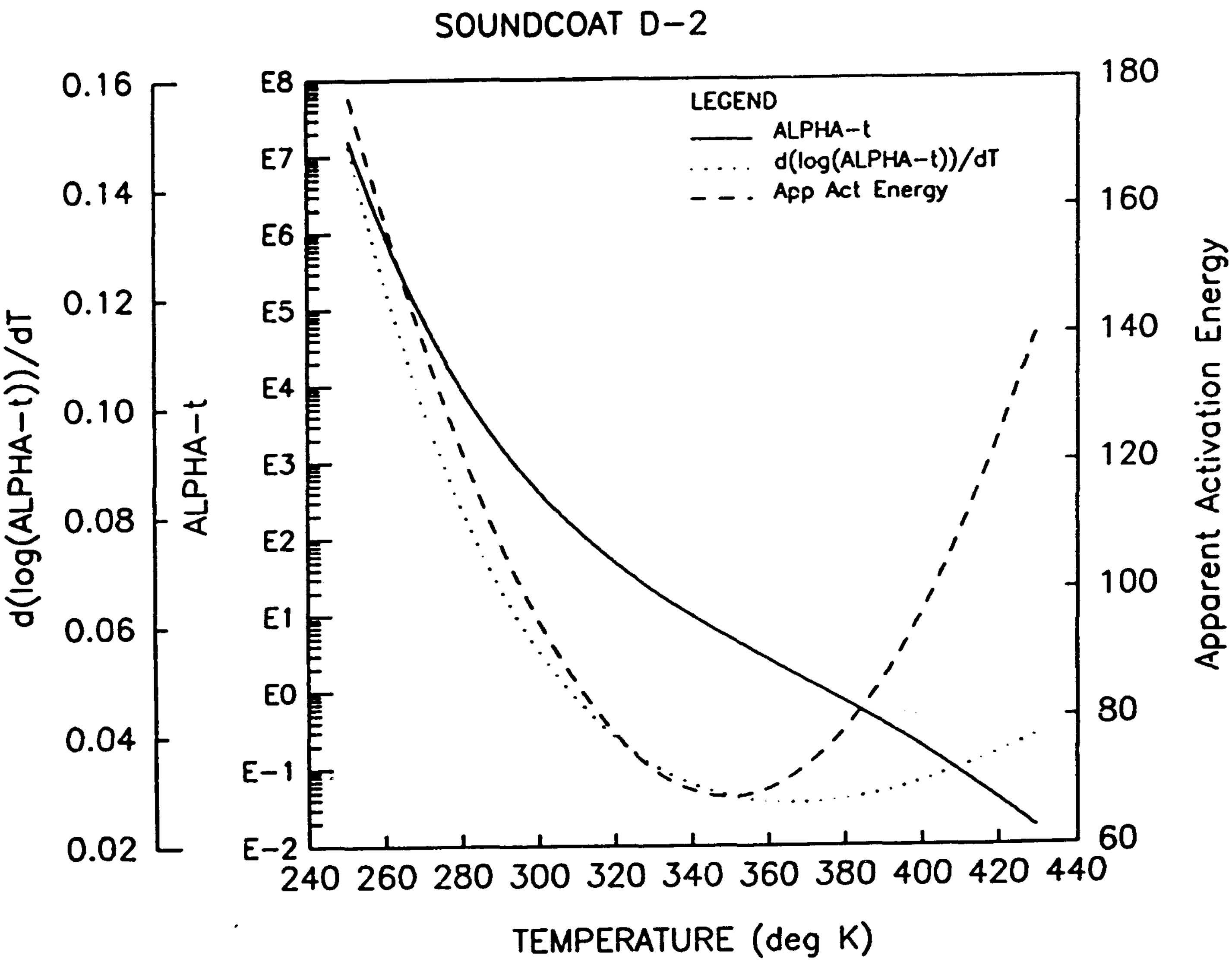
SOUNDCOAT D-2
SHEAR
Temperature (deg K)
410 380 340 310 290 270 260 250
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
E2
E1
E0
E-1
E-2
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
FREQUENCY (Hz)
E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12
REDUCED FREQUENCY (Hz)


SOUNDCOAT D-2
SHEAR
Temperature (deg F)
290 230 170 110 70 50 30 10 -10
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E1
E0
E-1
E-2
E-3
FREQUENCY (Hz)
E4
E3
E2
E1
E0
REDUCED FREQUENCY (Hz)
E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12


SOUNDCOAT D-2
FREQUENCY (Hz)
E4
E3
E2
240
260
280
300
320
340
360
380
400
420
440
TEMPERATURE (deg K)
0
50
100
150
200
250
300
TEMPERATURE (deg F)


SOUNDCOAT D-2
LOSS FACTOR
E1
E0
E-1
E-1
E0
E1
E2
MAGNITUDE MODULUS (MPa)


SOUNDCOAT D-2
LEGEND
REAL
IMAG
LOSS
E2
E1
E0
E-1
E-2
RE & IM MODULUS (MPa), LOSS FACTOR
240
260
280
300
320
340
360
380
400
420
440
TEMPERATURE (deg K)


SOUNDCOAT D-2
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
ALPHA-t
Apparent Activation Energy
TEMPERATURE (deg K)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
180
160
140
120
100
80
60
240 260 280 300 320 340 360 380 400 420 440

SOUNDCOAT D-2 SHEAR

ALPA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	375.0	250.0	430.0	0.2500E-01	0.1500	0.4000E-01

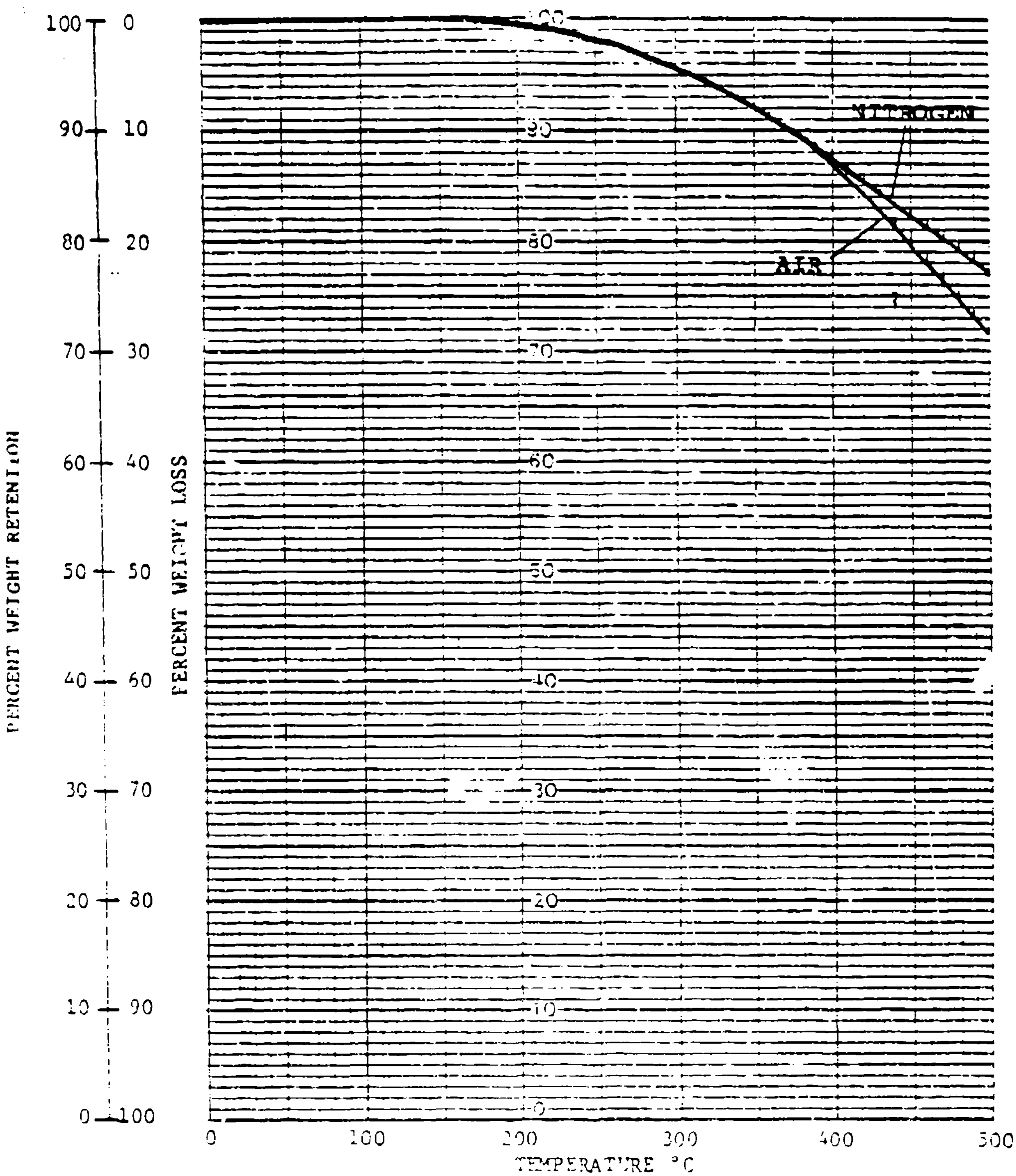
COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.4000E-01	40.00	0.5000E+06	0.5000	2.000	0.2000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
254.8	472.2	19.91	0.1282	2.552
254.8	1221.	21.84	0.1217	2.658
254.8	2244.	25.53	0.1159	2.959
254.8	3592.	33.08	0.1296	4.287
267.6	462.8	14.69	0.1577	2.317
267.6	1181.	16.13	0.1598	2.578
267.6	2174.	20.05	0.1469	2.945
267.6	3461.	25.68	0.1576	4.047
283.2	452.1	12.31	0.2477	3.049
283.2	1153.	14.17	0.2172	3.078
283.2	2079.	15.67	0.2458	3.852
283.2	3298.	19.99	0.2337	4.672
297.0	431.8	7.902	0.3408	2.693
297.0	1090.	9.570	0.2992	2.863
297.0	1955.	10.83	0.2988	3.236
297.0	3078.	13.34	0.3293	4.393
310.9	407.2	4.900	0.4587	2.248
310.9	1029.	6.572	0.3906	2.567
310.9	1837.	7.467	0.3943	2.944
310.9	2876.	8.874	0.4265	3.785
324.8	376.9	2.795	0.6220	1.738
324.8	952.7	4.029	0.5245	2.113
324.8	1718.	4.929	0.5233	2.579
324.8	2679.	5.573	0.5580	3.110
338.7	347.3	1.602	0.8140	1.304
338.7	883.1	2.486	0.6685	1.662
338.7	1593.	2.975	0.6526	1.941
338.7	2522.	3.546	0.6660	2.362
352.6	315.3	0.8308	1.002	0.8325
352.6	818.1	1.669	0.7665	1.279
352.6	1496.	1.819	0.7629	1.388
352.6	2393.	2.216	0.7205	1.597
366.5	291.1	0.4747	1.031	0.4894
366.5	756.2	0.7964	0.8722	0.6946
366.5	1416.	1.050	0.8641	0.9073
366.5	2317.	1.558	0.7208	1.123
358.2	307.4	0.7123	0.9607	0.6843
358.2	792.3	1.165	0.8628	1.005
358.2	1469.	1.558	0.7795	1.214
358.2	2367.	1.986	0.7272	1.444

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
347.0	330.7	1.178	0.8638	1.018
347.0	848.4	1.867	0.7376	1.377
347.0	2458.	2.872	0.6904	1.983
330.4	366.4	2.310	0.6780	1.566
330.4	922.3	3.305	0.5559	1.837
330.4	1668.	4.029	0.5595	2.254
330.4	2623.	4.807	0.5884	2.828
380.4	273.8	0.2961	1.001	0.2964
380.4	723.9	0.5049	1.010	0.5099
380.4	1374.	0.6716	0.9091	0.6106
394.3	257.6	0.1573	0.9989	0.1571
394.3	688.7	0.2425	1.129	0.2738
394.3	1338.	0.4616	0.7559	0.3489
394.3	2203.	0.7522	0.6098	0.4587
408.2	252.3	0.1282	0.8604	0.1103
408.2	681.2	0.2162	0.7914	0.1711
408.2	1321.	0.3618	0.6998	0.2532
408.2	2184.	0.6754	0.5152	0.3480
422.0	246.7	0.9798E-01	0.7403	0.7253E-01
422.0	671.0	0.1489	0.8234	0.1226
422.0	1302.	0.2626	0.6400	0.1681
422.0	2150.	0.5118	0.4597	0.2351
347.0	1537.	2.274	0.7132	1.622
380.4	2284.	1.023	0.7858	0.8039



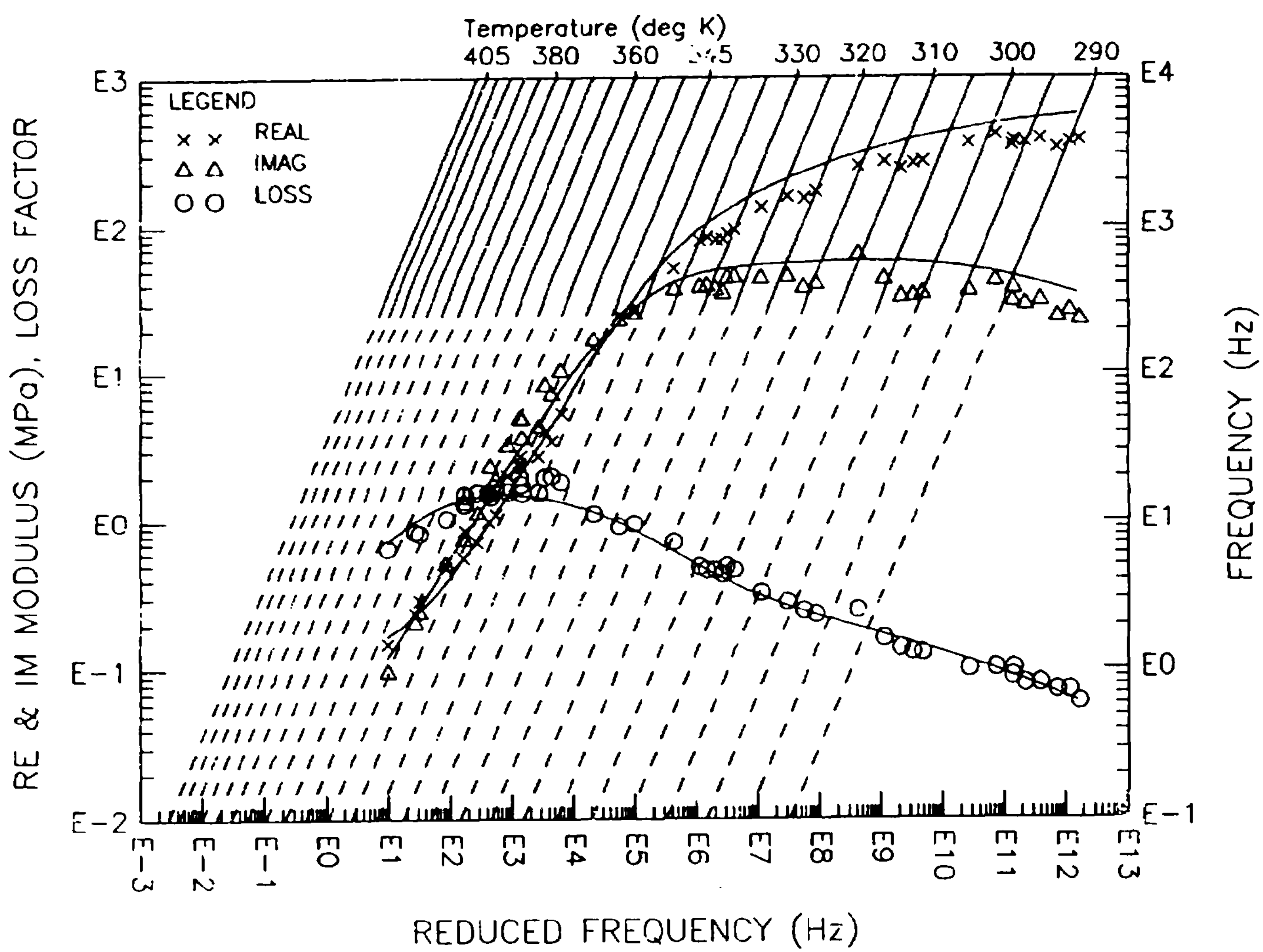
PERCENT WEIGHT RETENTION
PERCENT WEIGHT LOSS
NITROGEN
AIR
TEMPERATURE °C

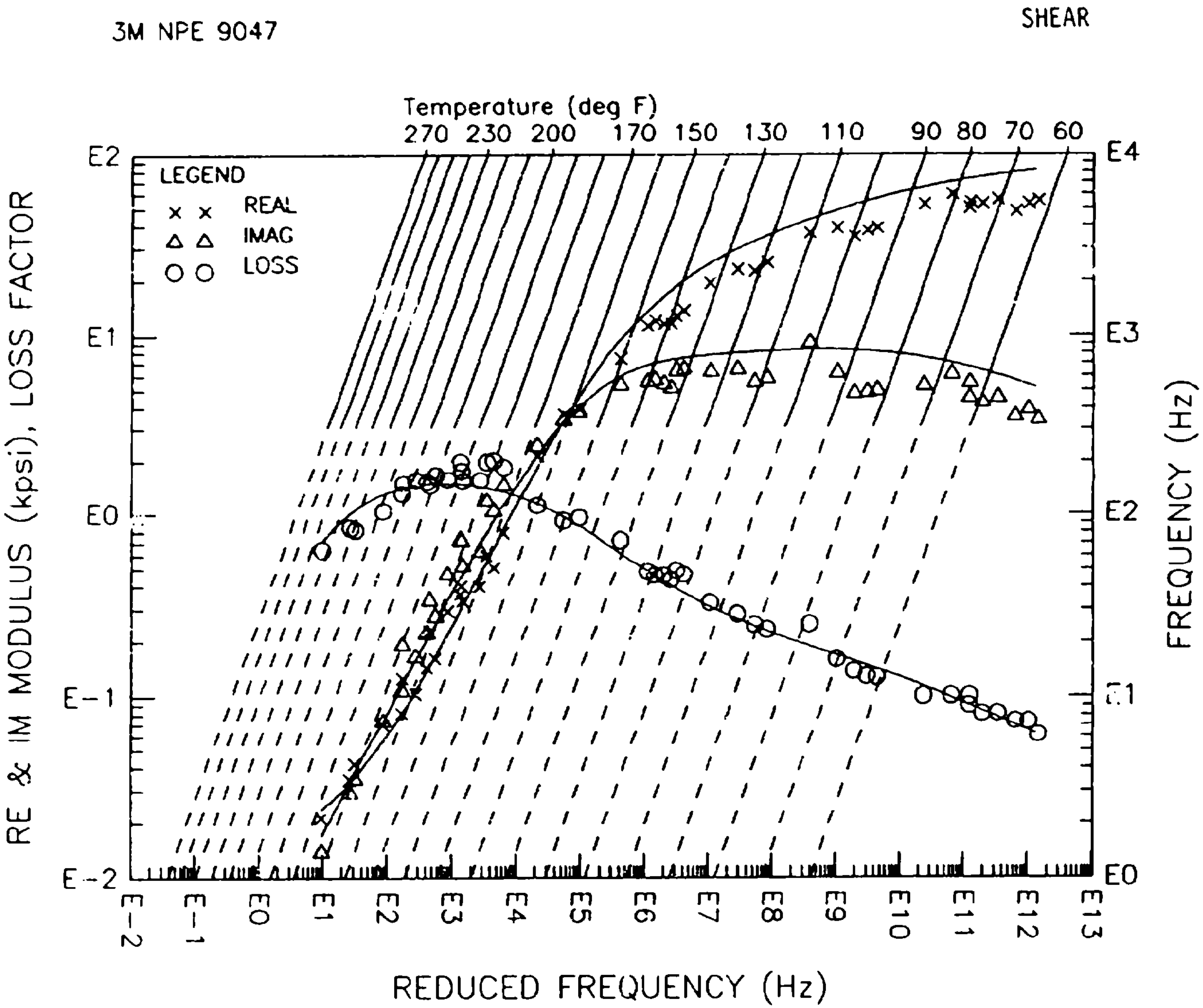
3M NPE 9047 SHEAR

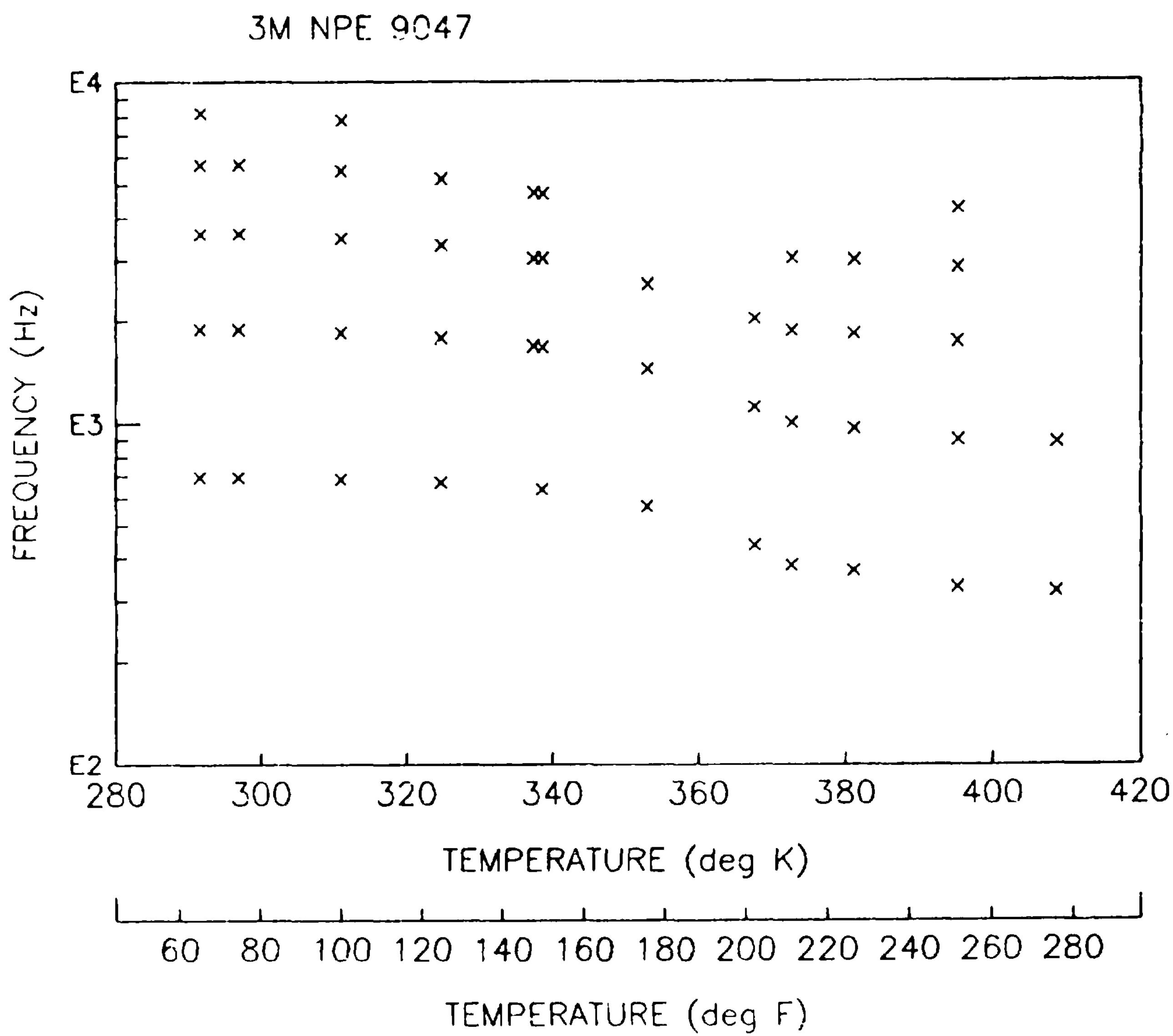
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.6123E-01	1.060	1.514	1.060	0.7150
MODULUS	MPA	566.2	20.66	1.418	0.2530	0.1663
	PSI	0.8212E+05	2996.	205.6	36.69	24.12
	DEG K		330.0	349.0	367.0	
10.HZ	DEG C		36.85	55.85	73.85	
	DEG F		98 33	132.5	164.9	
	DEG K		341.0	362.0	384.0	
100.HZ	DEG C		47.85	68.85	90.85	
	DEG F		118.1	155.9	195.5	
	DEG K		352.0	377.0	407.0	
1000.HZ	DEG C		58.85	83.85	113.9	
	DEG F		137.9	182.9	236.9	

3M NPE 9047

SHEAR

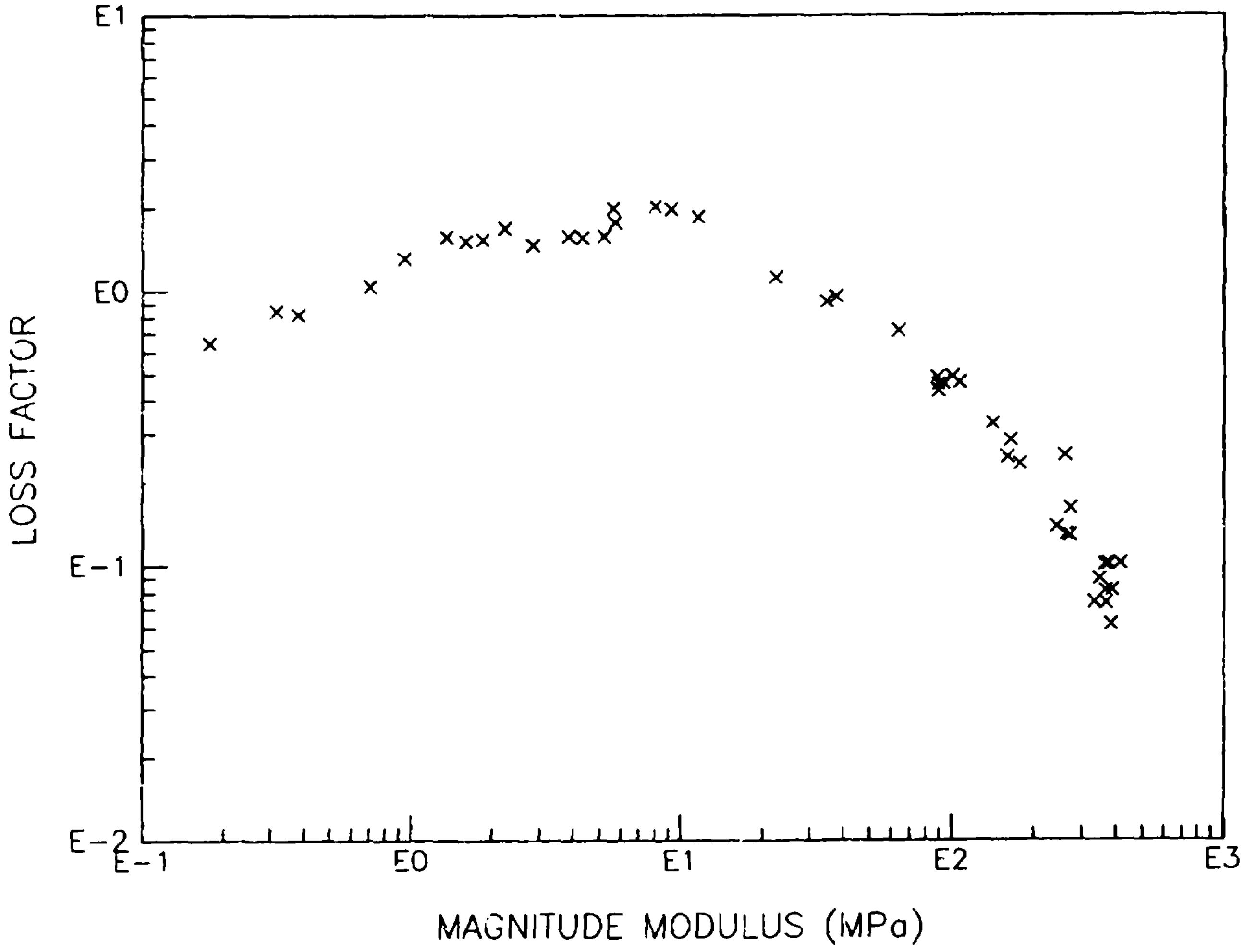


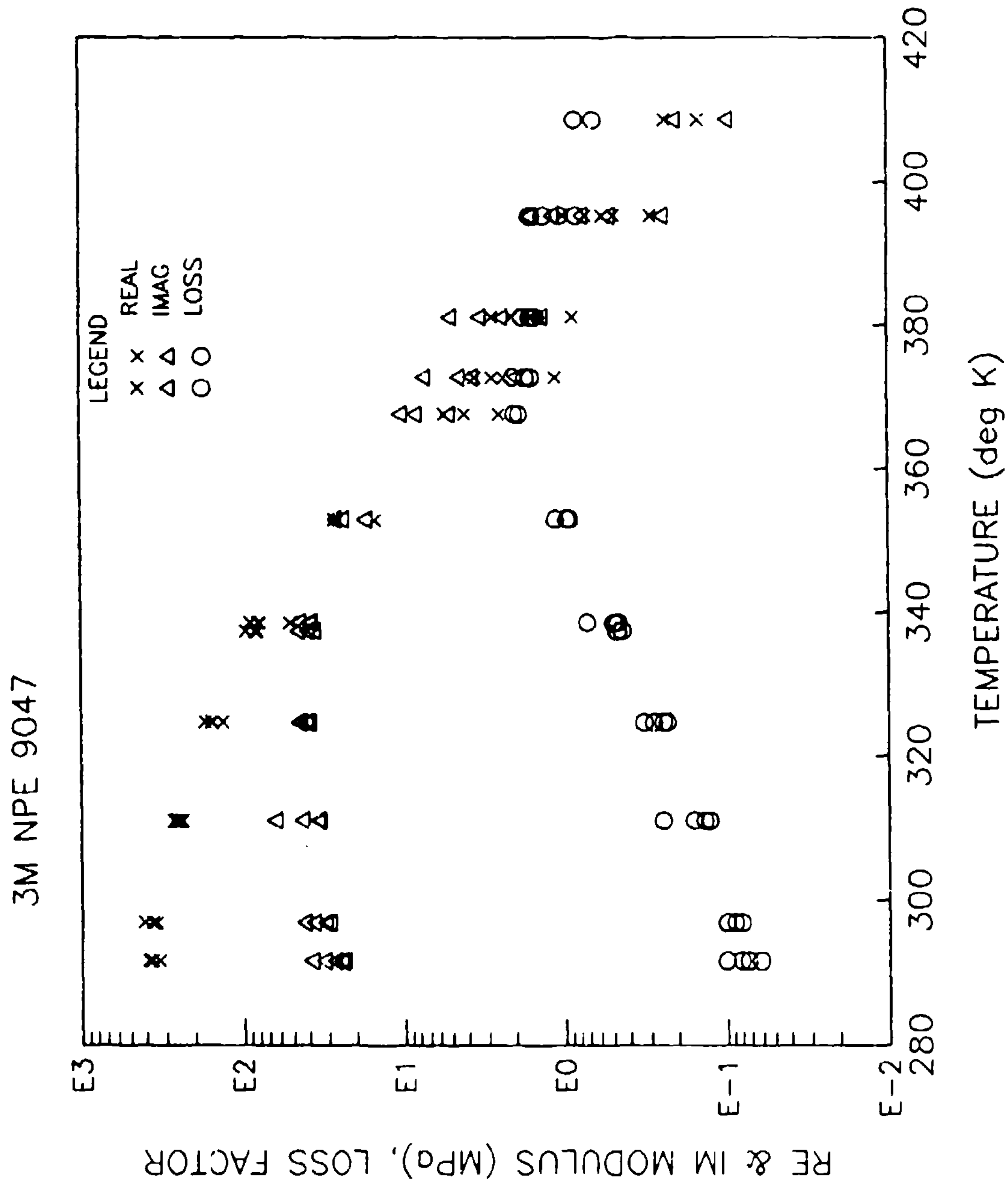

3M NPE 9047
SHEAR
Temperature (deg F)
270 230 200 170 150 130 110 90 80 70 60
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E2
E1
E0
E−1
E−2
E4
E3
E2
E1
E0
FREQUENCY (Hz)
E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13
REDUCED FREQUENCY (Hz)

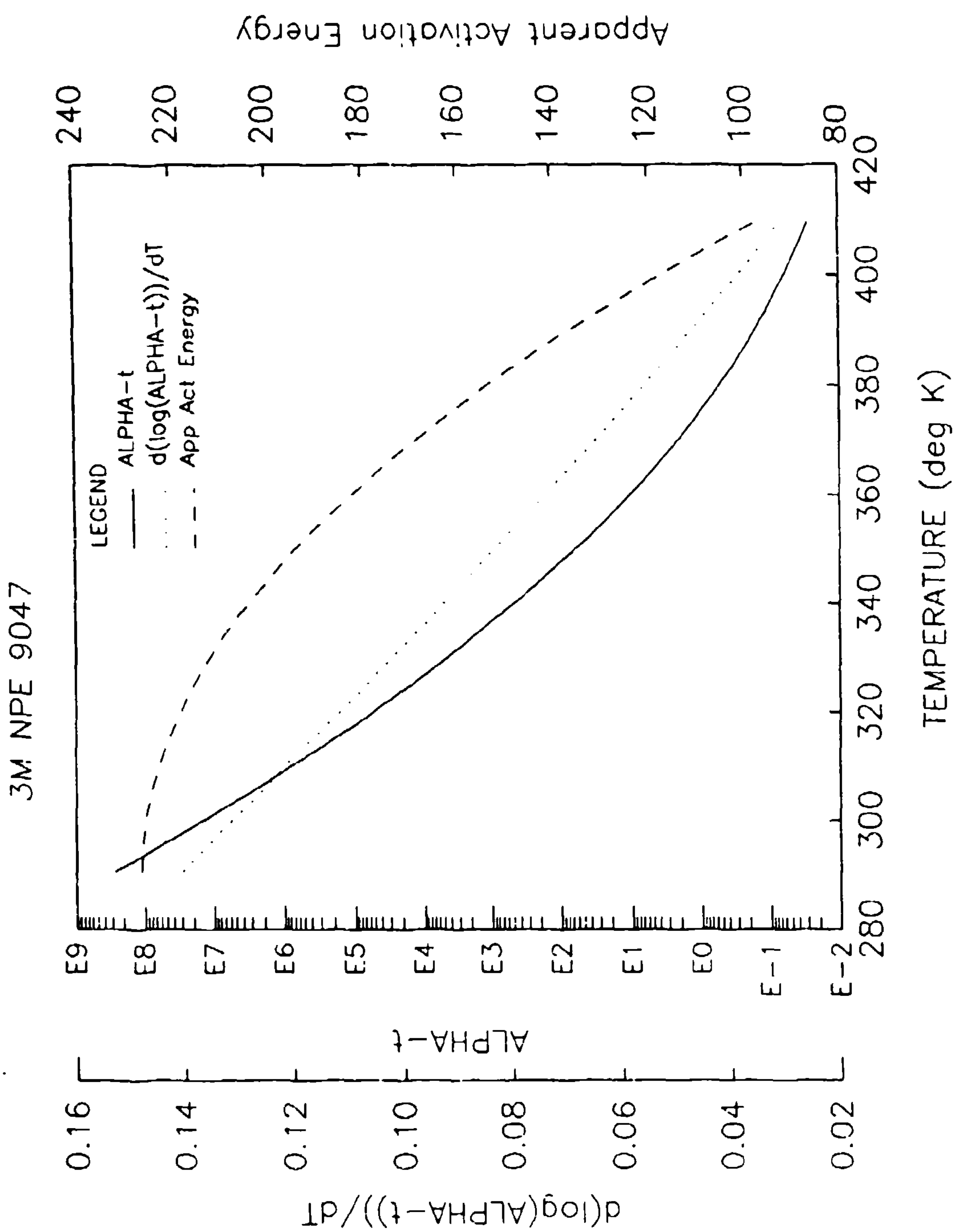


3M NPE 9047
FREQUENCY (Hz)
E4
E3
E2
280
300
320
340
360
380
400
420
TEMPERATURE (deg K)
60
80
100
120
140
160
180
200
220
240
260
280
TEMPERATURE (deg F)

3M NPE 9047




3M NPE 9047
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
E3
E2
E1
E0
E−1
E−2
280
300
320
340
360
380
400
420
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR


3M NPE 9047
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
280
300
320
340
360
380
400
420
ALPHA-t
E-2
E-1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
d(log(ALPHA-t))/dT
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Apparent Activation Energy
80
100
120
140
160
180
200
220
240

3M NPE 9047 SHEAR

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	375.0	290.0	410.0	0.6000E-01	0.1410	0.3000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.1000	700.0	0.2700E+07	0.6800	3.500	0.2000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

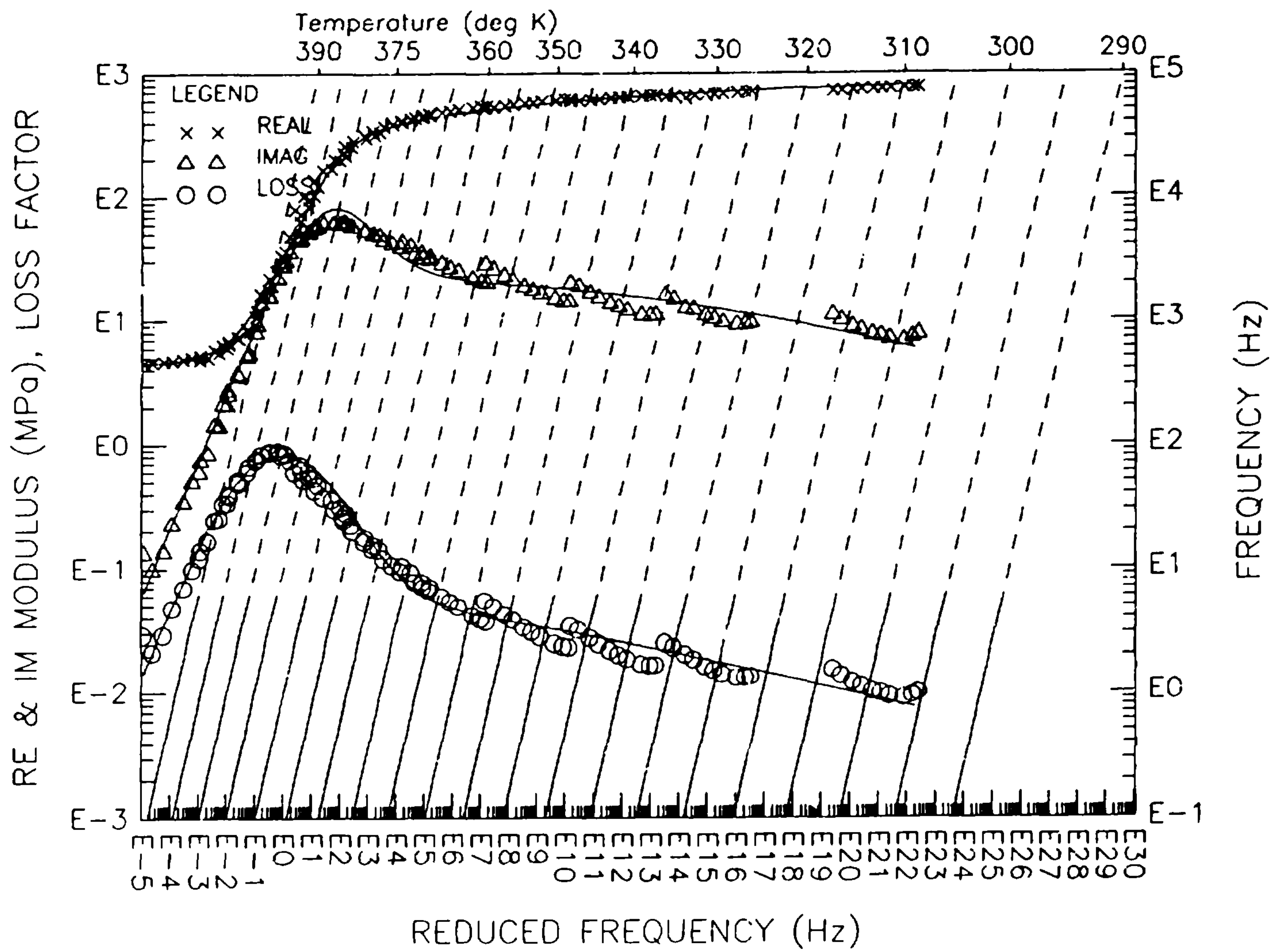
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
372.6	378.7	1.120	1.688	1.891
372.6	1004.	2.308	1.561	3.603
372.6	1868.	2.759	1.578	4.354
372.6	3043.	3.535	2.025	7.158
395.1	329.1	0.2903	0.8245	0.2394
395.1	898.4	0.4829	1.046	0.5051
395.1	1738.	0.5648	1.316	0.7433
395.1	2866.	0.7191	1.575	1.133
395.1	4277.	0.9949	1.545	1.537
408.5	319.0	0.1476	0.6467	0.9545E-01
408.5	878.0	0.2383	0.8480	0.2021
291.4	692.1	372.1	0.1010	37.58
291.4	1888.	383.3	0.8125E-01	31.14
291.4	3559.	330.7	0.7359E-01	24.34
291.4	5691.	364.7	0.7325E-01	26.71
291.4	8188.	379.8	0.6141E-01	23.32
310.8	683.2	250.6	0.2494	62.50
310.8	1848.	267.6	0.1600	42.82
310.8	3452.	230.2	0.1373	32.84
310.8	5475.	259.3	0.1288	33.40
310.8	7810.	267.7	0.1275	34.13
337.2	1696.	83.91	0.4652	39.03
337.2	3043.	81.09	0.4371	35.44
337.2	4768.	95.63	0.4683	44.78
352.8	567.9	14.83	1.123	16.65
352.8	1468.	25.23	0.9225	23.27
352.8	2581.	26.97	0.9612	25.92
367.5	434.7	2.502	1.994	4.989
367.5	1113.	4.114	1.986	8.170
367.5	2022.	5.468	1.855	10.14
381.0	365.4	0.8708	1.521	1.324
381.0	961.8	1.580	1.469	2.321
381.0	1826.	2.033	1.588	3.228
381.0	2990.	2.769	1.775	4.915
296.7	691.2	360.4	0.1008	36.33
296.7	1886.	410.2	0.1014	41.59
296.7	3562.	345.3	0.8955E-01	30.92
296.7	5685.	362.7	0.8089E-01	29.34
324.5	667.5	133.6	0.3260	43.55
324.5	1787.	158.0	0.2834	44.78

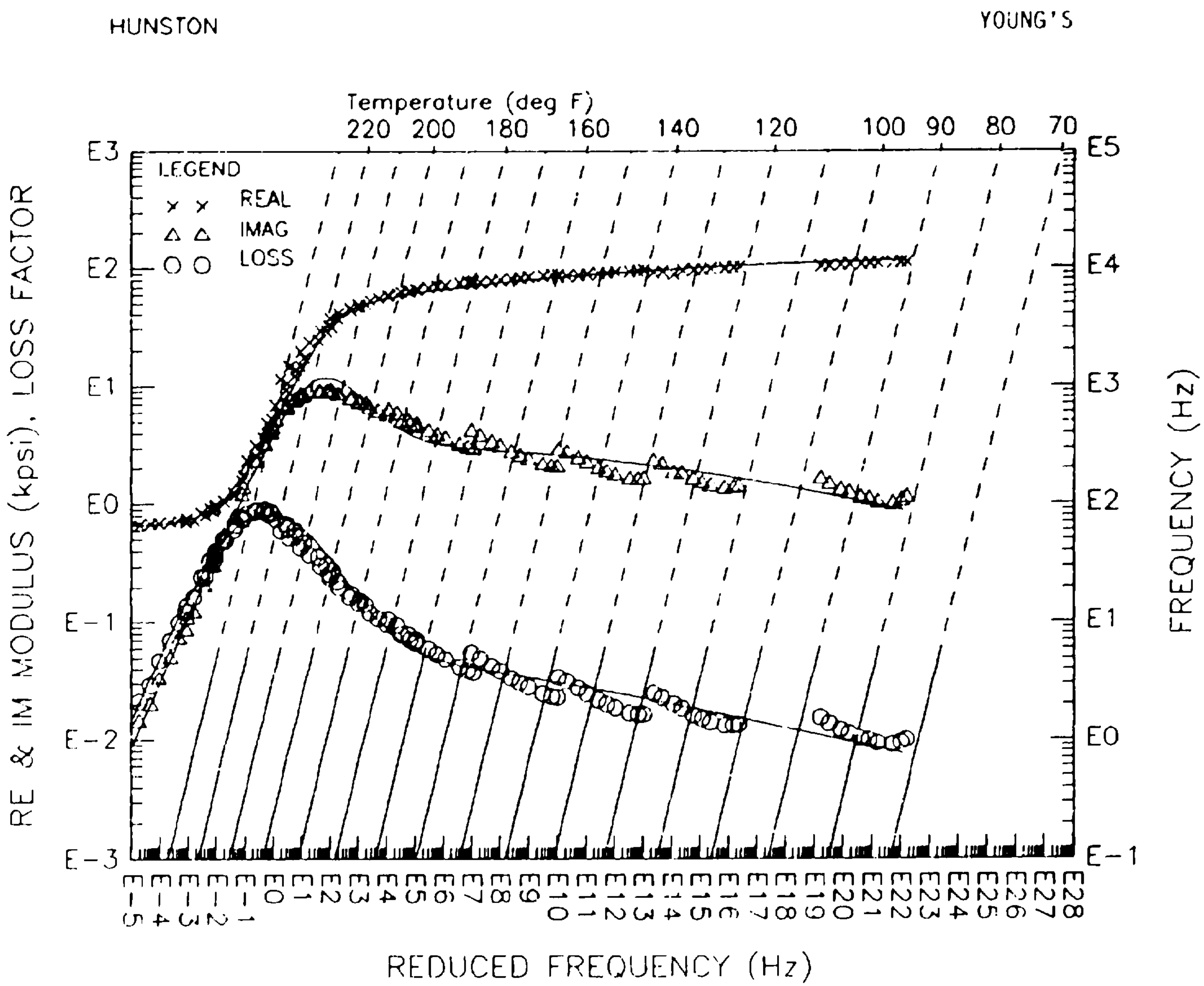
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
324.5	3299.	184.4	0.2472	38.17
324.5	5194.	171.6	0.2332	40.02
338.4	638.8	51.30	0.7196	36.92
338.4	1686.	78.88	0.4868	38.40
338.4	3044.	80.46	0.4635	37.29
338.4	4731.	89.50	0.4918	44.02

HUNSTON YOUNG'S

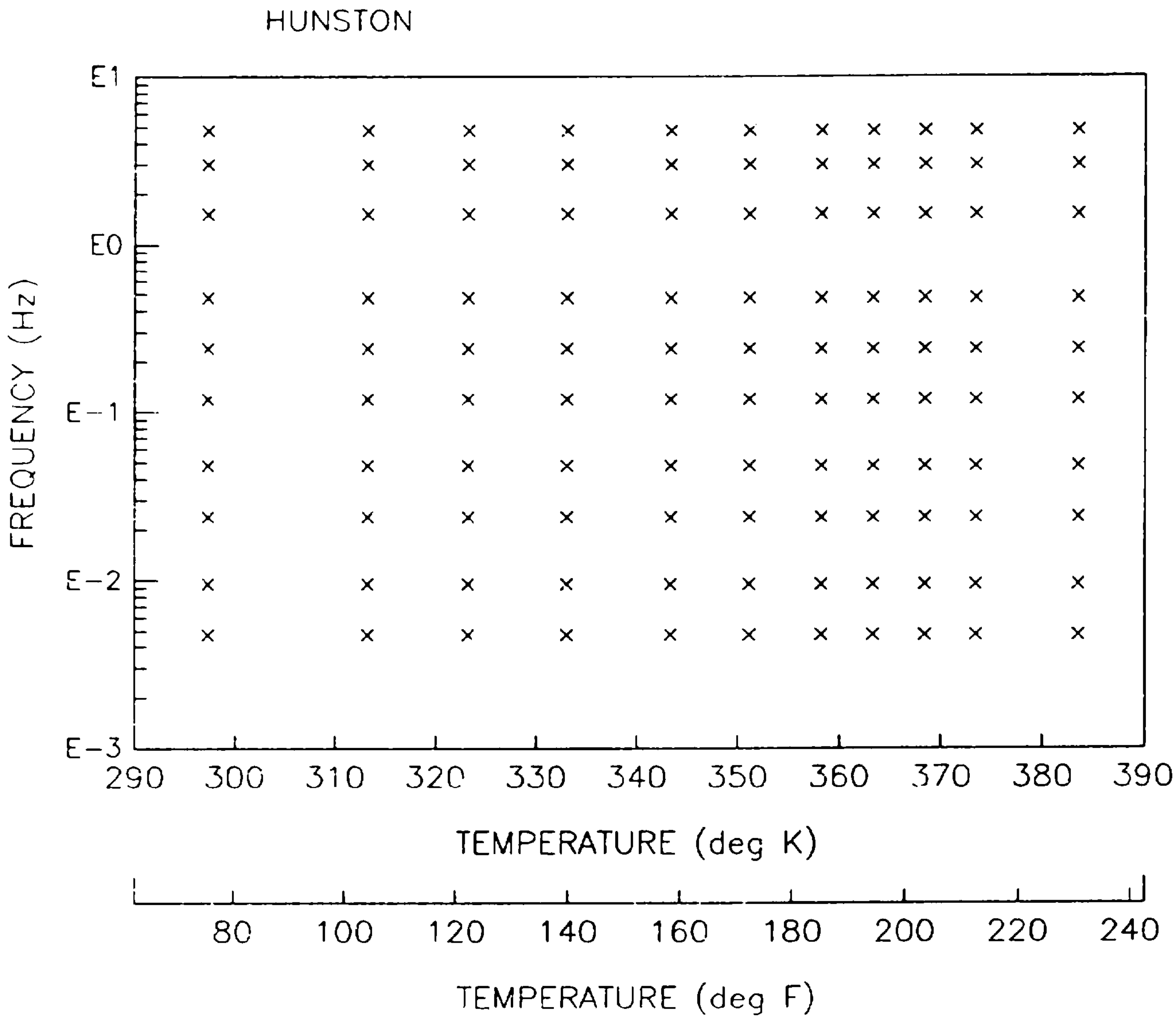
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.7423E-02	0.5748	0.8211	0.574[illegible]	0.1425E-01
MODULUS	MPA	788.5	144.3	32.28	9.575	4.556
	PSI	0.1144E+06	0.2093E+05	4681.	1389.	660.8
10.HZ	DEG K		368.0	375.0	382.0	
	DEG C		74.85	81.85	88.85	
	DEG F		166.7	179.3	191.9	
100.HZ	DEG K		373.0	381.0	387.0	
	DEG C		79.85	87.85	93.85	
	DEG F		175.7	190.1	200.9	
1000.HZ	DEG K		378.0	386.0	390.0	
	DEG C		84.85	92.85	96.85	
	DEG F		184.7	199.1	206.3	

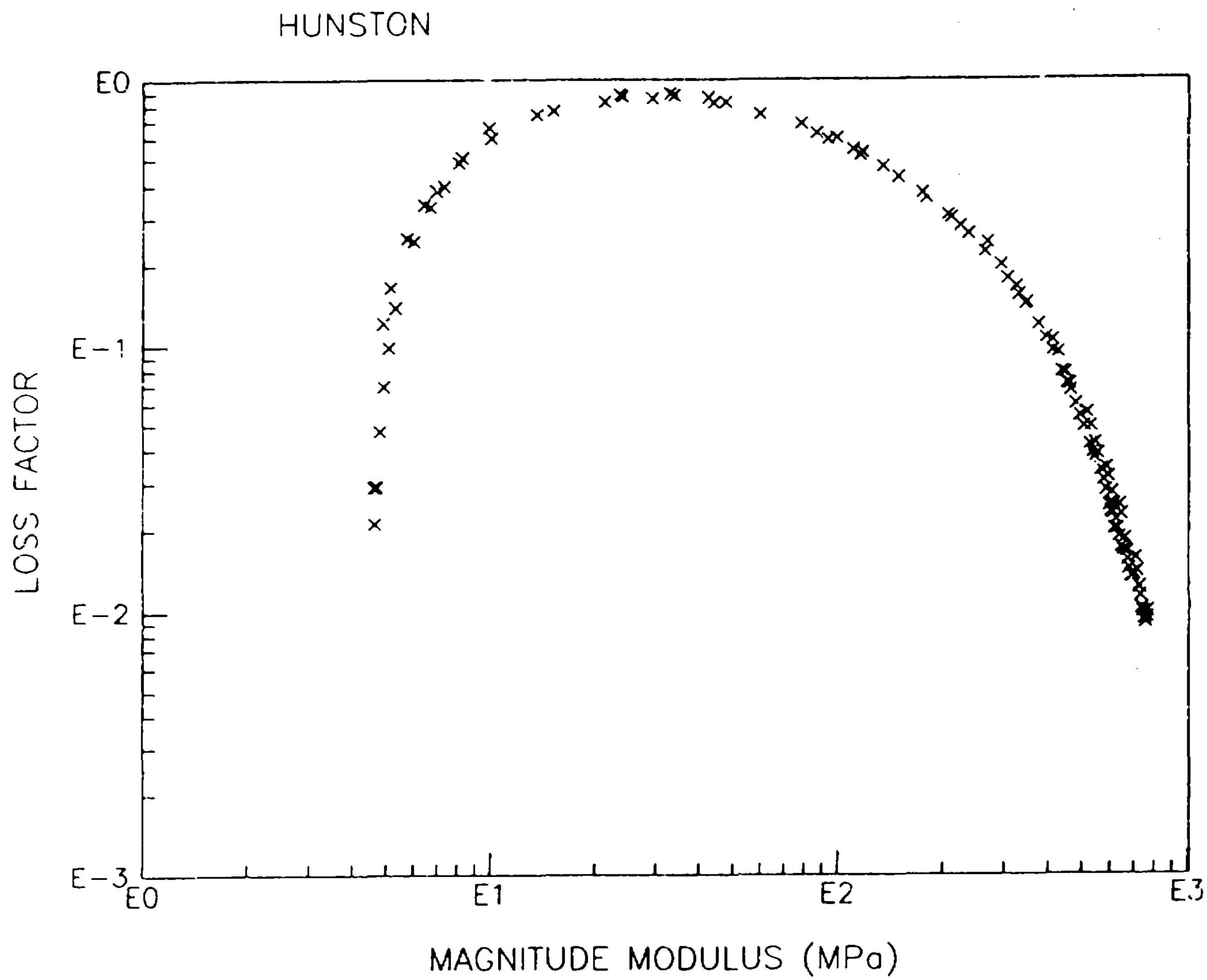
HUNSTON YOUNG'S

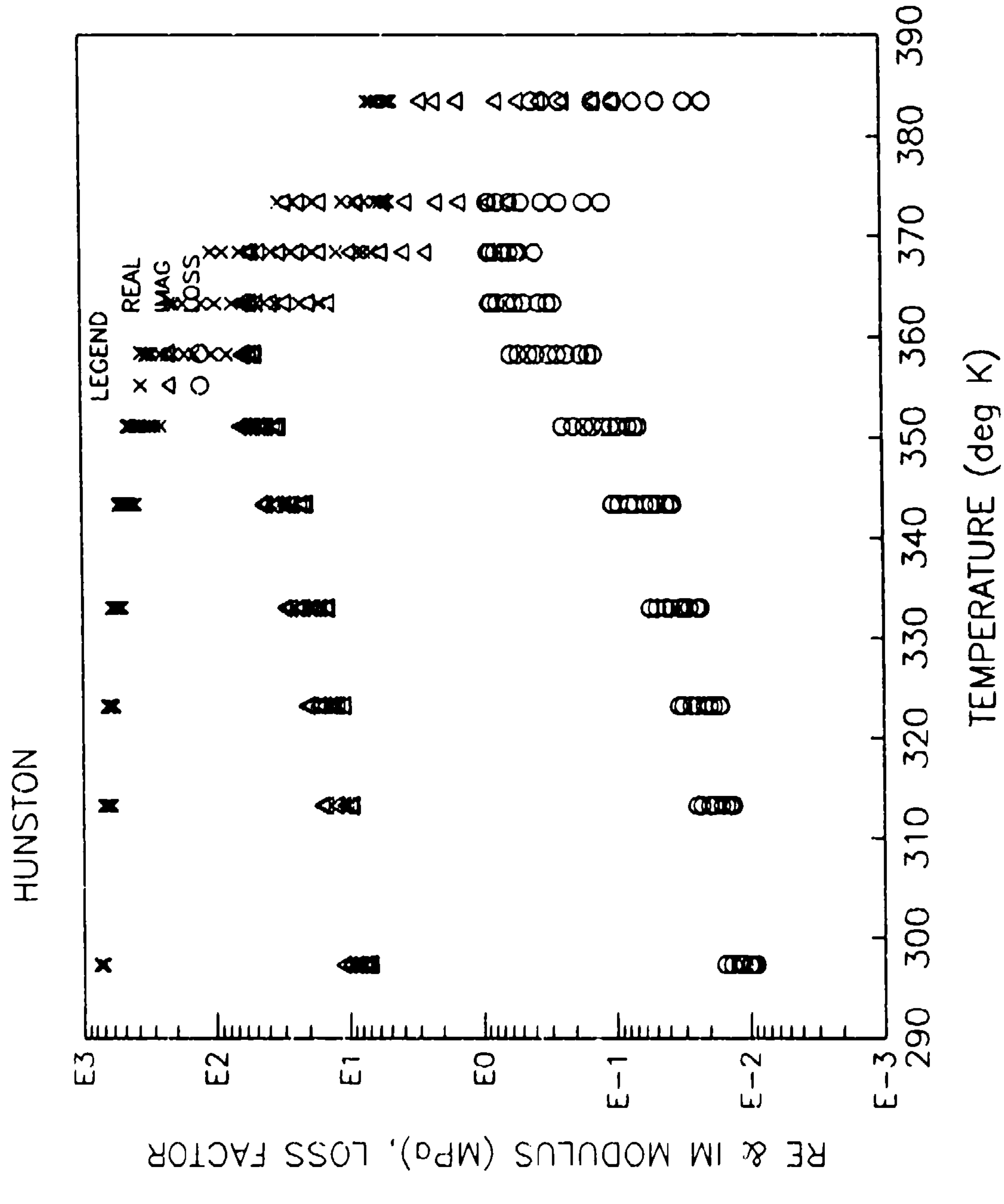


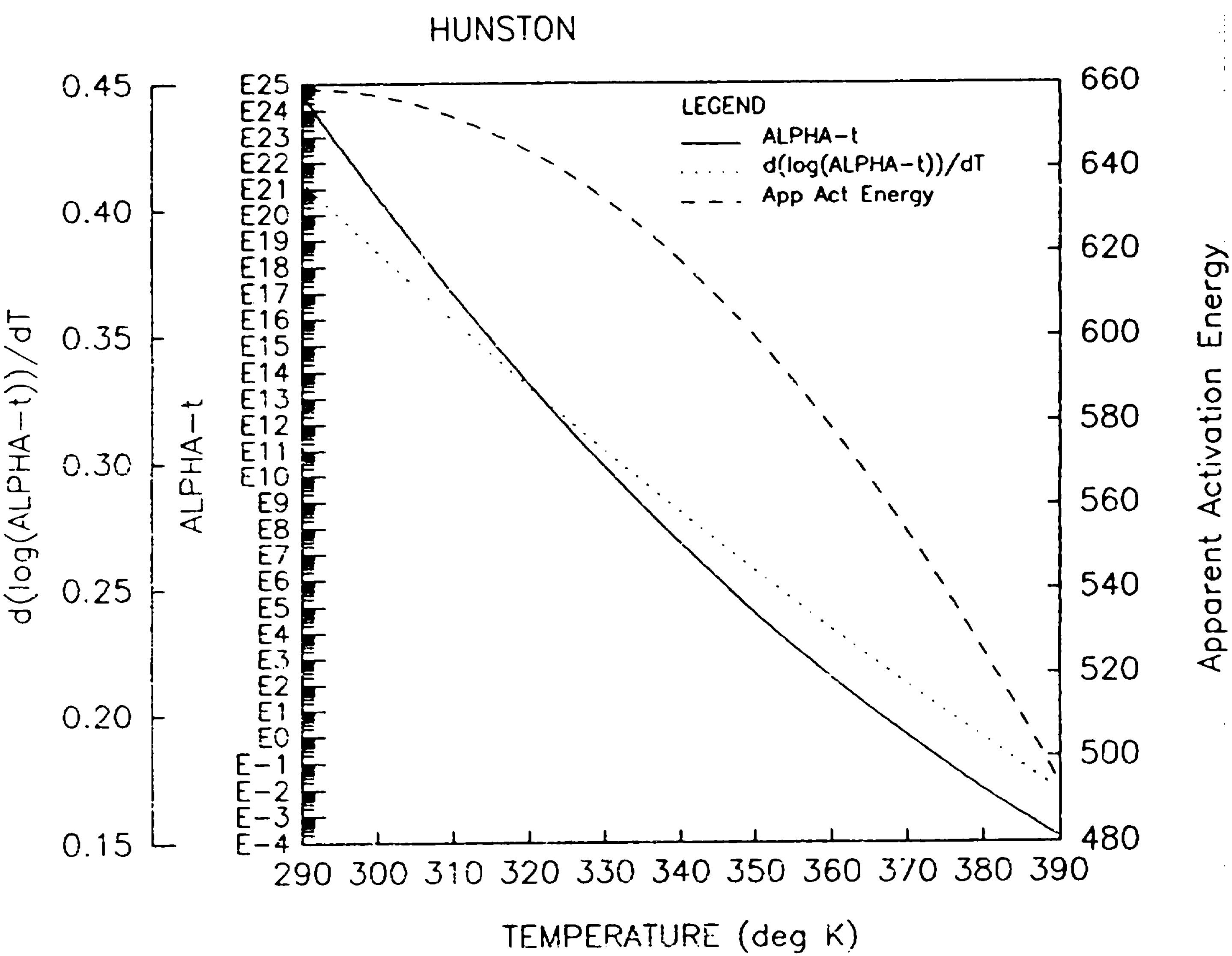


HUNSTON
YOUNG'S
Temperature (deg F)
220 200 180 160 140 120 100 90 80 70
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E3
E2
E1
E0
E-1
E-2
E-3
FREQUENCY (Hz)
E5
E4
E3
E2
E1
E0
E-1
E-5 E-4 E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28
REDUCED FREQUENCY (Hz)


HUNSTON
E1
E0
E−1
E−2
E−3
FREQUENCY (Hz)
290
300
310
320
330
340
350
360
370
380
390
TEMPERATURE (deg K)
80
100
120
140
160
180
200
220
240
TEMPERATURE (deg F)


HUNSTON
E0
E-1
E-2
E-3
LOSS FACTOR
E0
E1
E2
E3
MAGNITUDE MODULUS (MPa)


HUNSTON
LEGEND
× REAL
△ IMAG
○ LOSS
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
E−3
290
300
310
320
330
340
350
360
370
380
390



HUNSTON
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.45
0.40
0.35
0.30
0.25
0.20
0.15
ALPHA-t
E25
E24
E23
E22
E21
E20
E19
E18
E17
E16
E15
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
Apparent Activation Energy
660
640
620
600
580
560
540
520
500
480
290 300 310 320 330 340 350 360 370 380 390
TEMPERATURE (deg K)

HUNSTON YOUNG'S

ALFA-T MODEL							
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	370.0	290.0	390.0	0.2118	0.4108	0.1701

COMPLEX MODULUS MODEL							
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	4.500	850.0	223.8	0.5456	1.409	0.6110E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
297.2	4.762	760.3	0.9954E-02	7.568
297.2	3.005	758.6	0.9441E-02	7.162
297.2	1.506	751.6	0.8974E-02	6.745
297.2	0.4762	744.7	0.9290E-02	6.918
297.2	0.2387	739.6	0.9886E-02	7.312
297.2	0.1196	734.5	0.1021E-01	7.499
297.2	0.4762E-01	727.8	0.1130E-01	8.224
297.2	0.2387E-01	722.8	0.1211E-01	8.753
297.2	0.9502E-02	714.5	0.1371E-01	9.796
297.2	0.4762E-02	707.9	0.1542E-01	10.92
313.1	4.762	698.2	0.1349E-01	9.419
313.1	3.005	693.4	0.1321E-01	9.160
313.1	1.506	687.1	0.1321E-01	9.077
313.1	0.4762	677.6	0.1409E-01	9.547
313.1	0.2387	671.4	0.1510E-01	10.14
313.1	0.1196	665.3	0.1622E-01	10.79
313.1	0.4762E-01	657.7	0.1841E-01	12.11
313.1	0.2387E-01	615.2	0.2009E-01	12.36
313.1	0.9502E-02	642.7	0.2280E-01	14.65
313.1	0.4762E-02	635.3	0.2472E-01	15.70
323.1	4.762	657.7	0.1660E-01	10.92
323.1	3.005	651.6	0.1648E-01	10.74
323.1	1.506	645.7	0.1690E-01	10.91
323.1	0.4762	635.3	0.1871E-01	11.89
323.1	0.2387	628.1	0.2009E-01	12.62
323.1	0.1196	622.3	0.2178E-01	13.55
323.1	0.4762E-01	612.4	0.2472E-01	15.14
323.1	0.2387E-01	603.9	0.2742E-01	16.56
323.1	0.9502E-02	591.6	0.3141E-01	18.58
323.1	0.4762E-02	583.4	0.3388E-01	19.77
332.9	4.762	608.1	0.2301E-01	13.99
332.9	3.005	602.6	0.2339E-01	14.09
332.9	1.506	594.3	0.2460E-01	14.62
332.9	0.4762	580.8	0.2799E-01	16.26
332.9	0.2387	572.8	0.3048E-01	17.46
332.9	0.1196	563.6	0.3327E-01	18.75
332.9	0.4762E-01	550.8	0.3837E-01	21.13
332.9	0.2387E-01	540.8	0.4227E-01	22.86
332.9	0.9502E-02	526.0	0.4920E-01	25.88
332.9	0.4762E-02	515.2	0.5534E-01	28.51

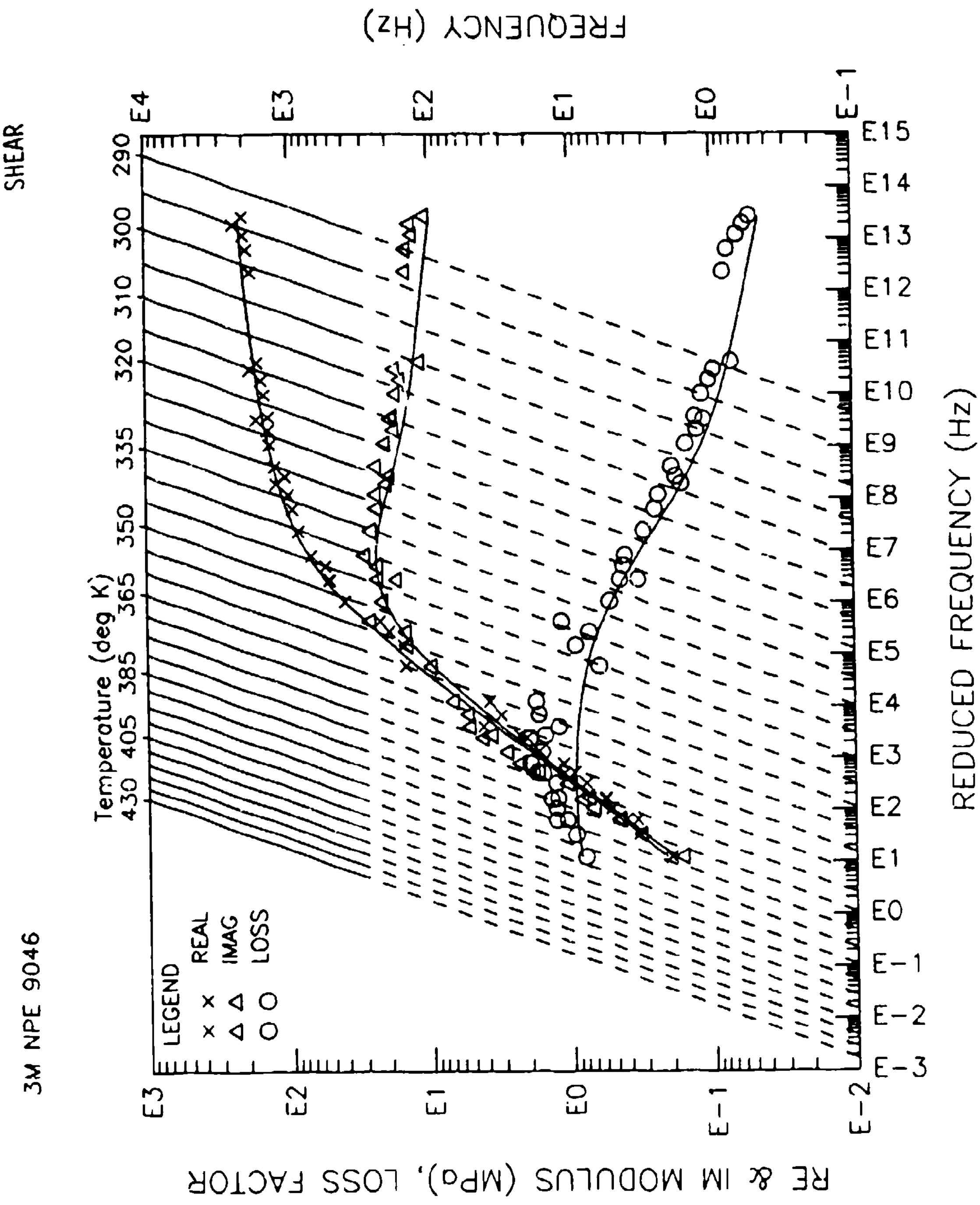
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
343.2	4.762	539.5	0.3707E-01	20.00
343.2	3.005	533.3	0.3873E-01	20.65
343.2	1.506	522.4	0.4169E-01	21.78
343.2	0.4762	503.5	0.4887E-01	24.61
343.2	0.2387	490.9	0.5370E-01	26.36
343.2	0.1196	477.5	0.5957E-01	28.44
343.2	0.4762E-01	457.1	0.7063E-01	32.28
343.2	0.2387E-01	444.6	0.7816E-01	34.75
343.2	0.9502E-02	422.7	0.9376E-01	39.63
343.2	0.4762E-02	406.4	0.1050	42.67
351.0	4.762	461.3	0.6683E-01	30.83
351.0	3.005	450.8	0.7129E-01	32.14
351.0	1.506	435.5	0.7870E-01	34.27
351.0	0.4762	407.4	0.9528E-01	38.82
351.0	0.2387	389.0	0.1069	41.58
351.0	0.1196	369.8	0.1199	44.34
351.0	0.4762E-01	341.2	0.1439	49.10
351.0	0.2387E-01	317.7	0.1648	52.36
351.0	0.9502E-02	285.8	0.2000	57.16
351.0	0.4762E-02	258.8	0.2421	62.66
358.1	4.762	338.1	0.1419	47.98
358.1	3.005	322.8	0.1542	49.78
358.1	1.506	299.2	0.1770	52.96
358.1	0.4762	255.9	0.2239	57.30
358.1	0.2387	228.0	0.2612	59.55
358.1	0.1196	200.9	0.3020	60.67
358.1	0.4762E-01	162.2	0.3741	60.68
358.1	0.2387E-01	136.1	0.4276	58.20
358.1	0.9502E-02	102.1	0.5176	52.85
358.1	0.4762E-02	79.80	0.5929	47.31
363.2	4.762	214.8	0.2793	59.99
363.2	3.005	196.8	0.3083	60.67
363.2	1.506	167.9	0.3597	60.39
363.2	0.4762	121.1	0.4677	56.64
363.2	0.2387	96.16	0.5433	52.24
363.2	0.1196	72.95	0.6266	45.71
363.2	0.4762E-01	47.42	0.7482	35.48
363.2	0.2387E-01	33.50	0.8241	27.61
363.2	0.9502E-02	21.98	0.8590	18.88
363.2	0.4762E-02	16.22	0.8316	13.49
368.3	4.762	103.0	0.5309	54.68
368.3	3.005	84.33	0.5998	50.58
368.3	1.506	64.27	0.6839	43.95
368.3	0.4762	36.22	0.8299	30.06
368.3	0.2387	25.18	0.8810	22.18
368.3	0.1196	17.91	0.8710	15.60
368.3	0.4762E-01	11.91	0.7709	9.181
368.3	0.2387E-01	8.155	0.6607	5.408
368.3	0.9502E-02	7.328	0.5058	3.707
368.3	0.4762E-02	6.471	0.3837	2.483
373.3	4.762	31.77	0.8630	27.42
373.3	3.005	24.32	0.8933	21.73
373.3	1.506	17.50	0.8851	15.49
373.3	0.4762	10.79	0.7430	8.017
373.3	0.2387	8.531	0.5998	5.117
373.3	0.1196	7.228	0.4864	3.516
373.3	0.4762E-01	6.053	0.3388	2.051

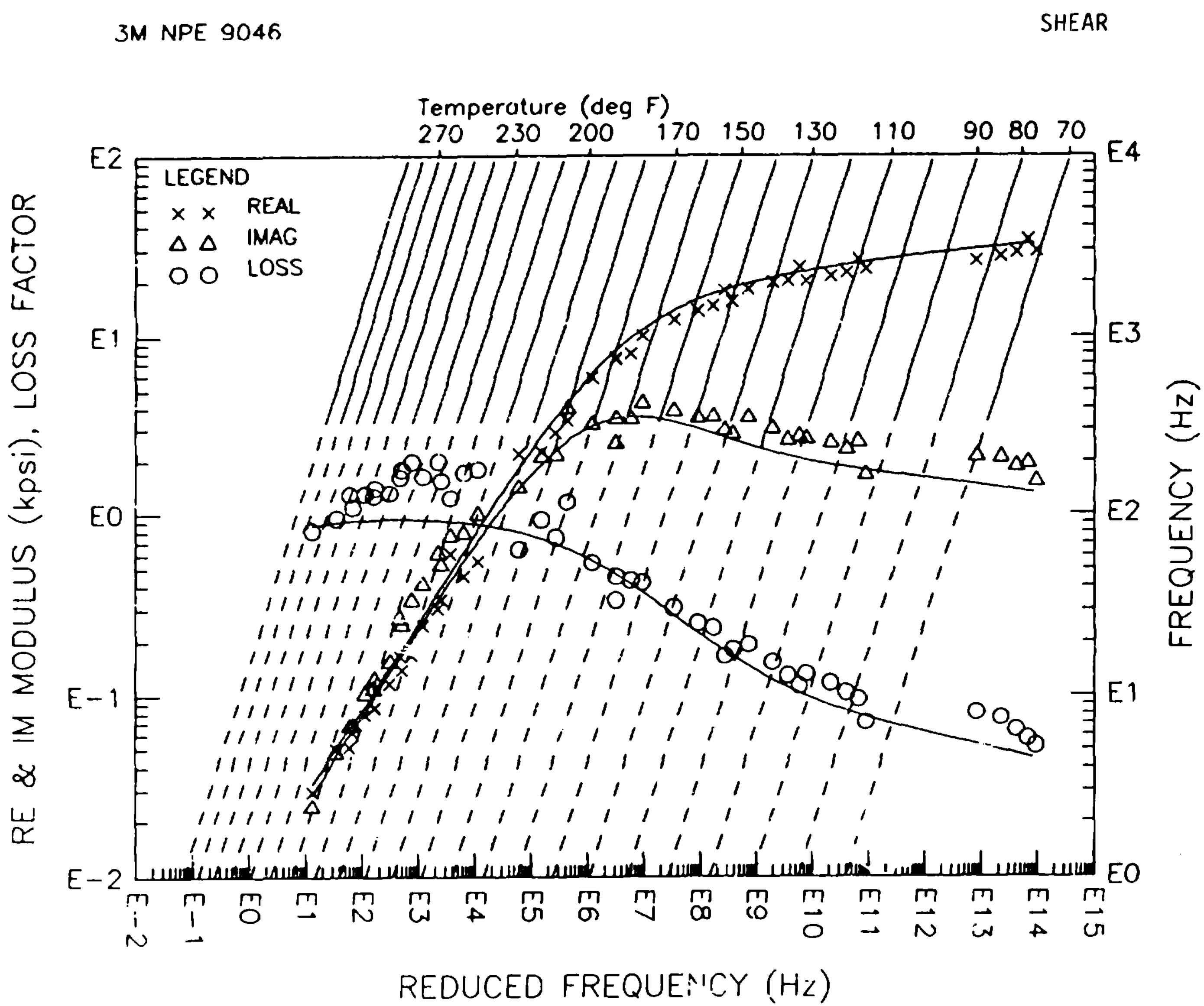
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
373.3	0.2387E-01	5.534	0.2512	1.390
373.3	0.9502E-02	5.047	0.1648	0.8317
373.3	0.4762E-02	4.831	0.1211	0.5850
383.4	4.762	6.776	0.3972	2.691
383.4	3.005	6.324	0.3319	2.099
383.4	1.506	5.794	0.2460	1.425
383.4	0.4762	5.236	0.1390	0.7278
383.4	0.2387	5.035	0.9840E-01	0.4954
383.4	0.1196	4.887	0.6966E-01	0.3404
383.4	0.4762E-01	4.753	0.4732E-01	0.2249
383.4	0.2387E-01	4.677	0.2911E-01	0.1361
383.4	0.9502E-02	4.603	0.2118E-01	0.9749E-01
383.4	0.4762E-02	4.581	0.2897E-01	0.1327

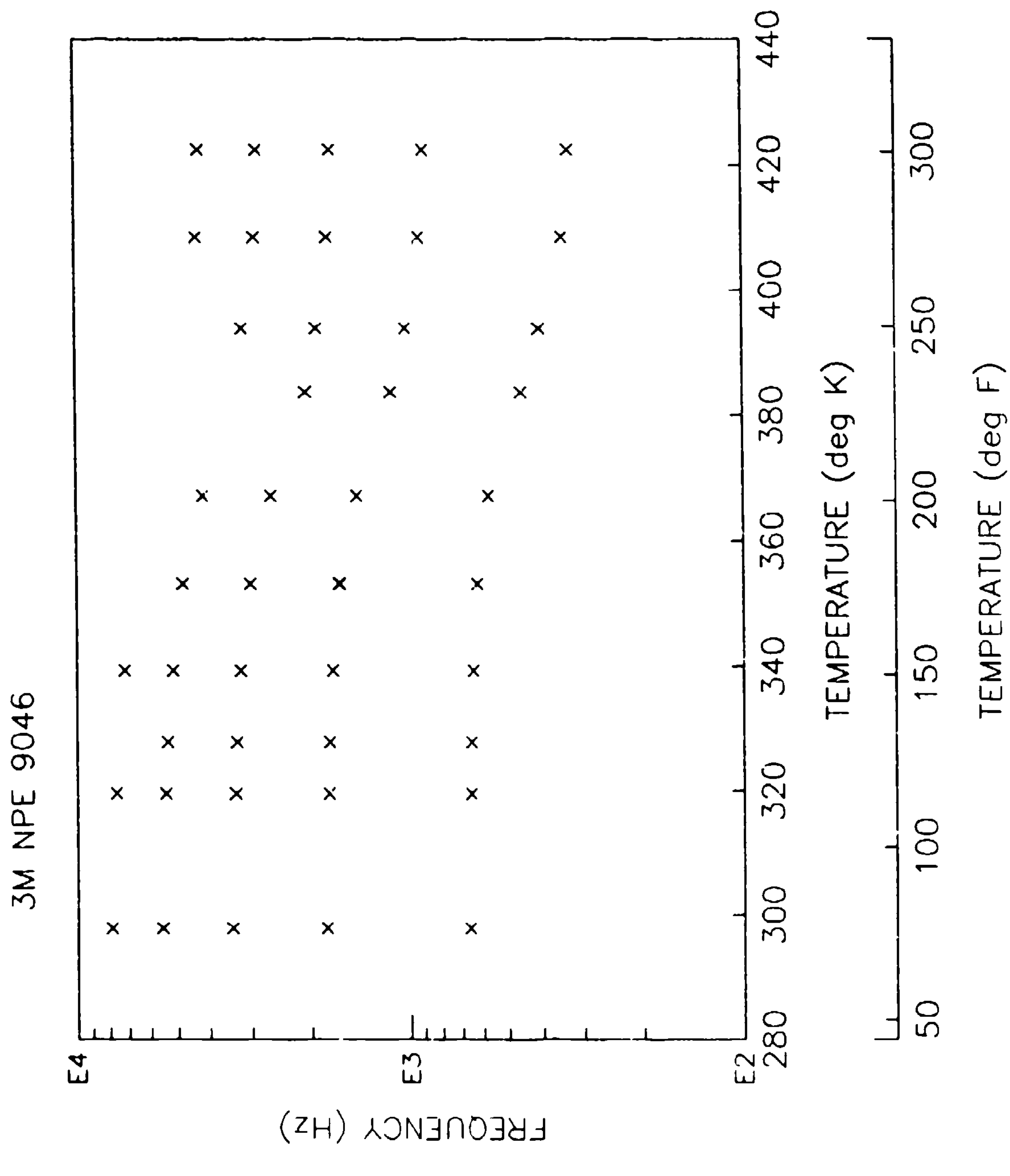
3M NPE 9046

SHEAR

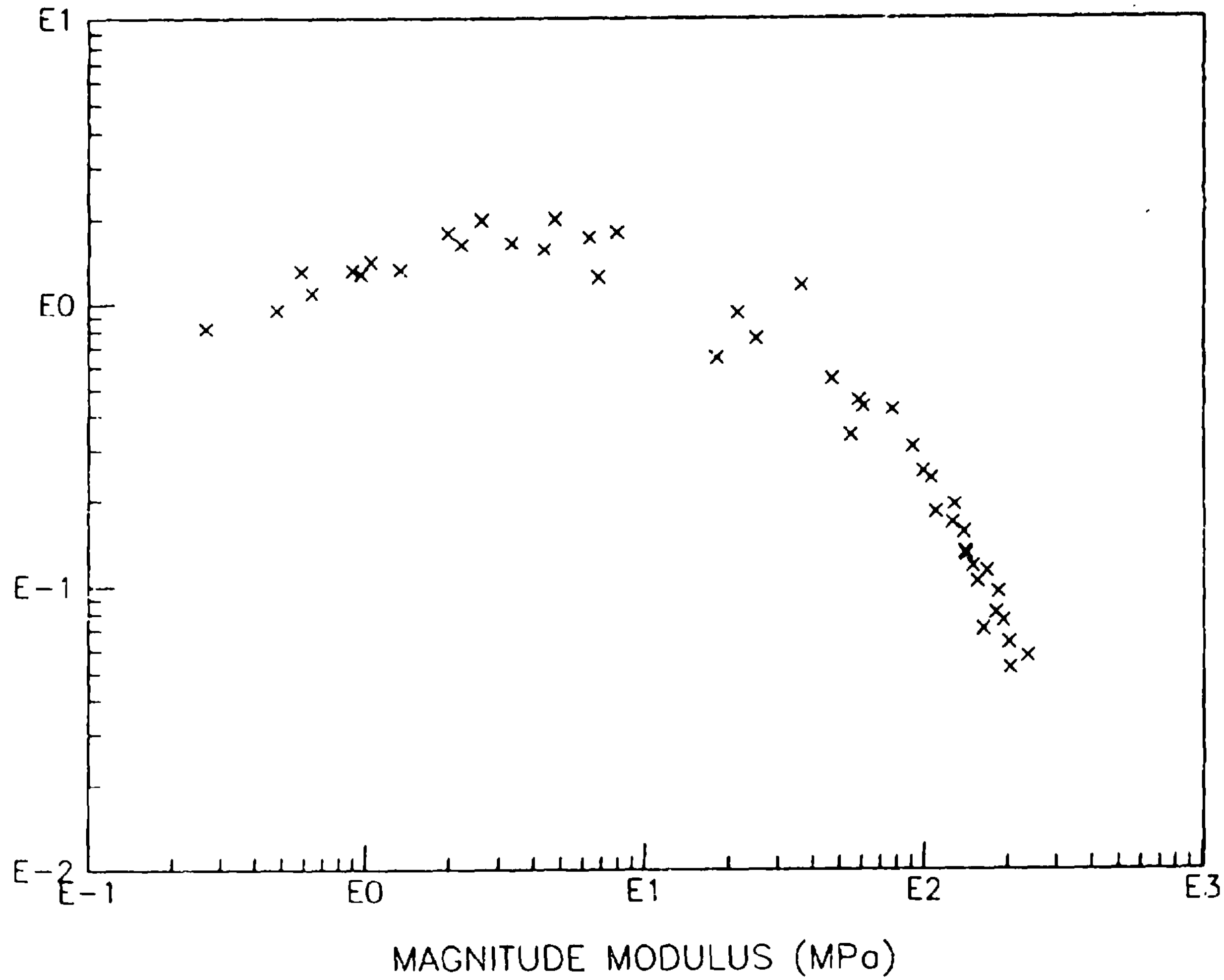
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.4439E-01	0.6570	0.9386	0.6570	0.8657
MODULUS	MPA	216.1	24.99	1.041	0.8263E-01	0.2189
	PSI	0.3135E+05	3624.	150.9	11.98	31.75
10.HZ	DEG K		340.0	373.0	413.0	
	DEG C		46.85	79.85	119.9	
	DEG F		116.3	175.7	247.7	
100.HZ	DEG K		351.0	387.0	430.0	
	DEG C		57.85	93.85	136.9	
	DEG F		136.1	200.9	278.3	
1000.HZ	DEG K		362.0	403.0	430.0	
	DEG C		68.85	109.9	136.9	
	DEG F		155.9	229.7	278.3	

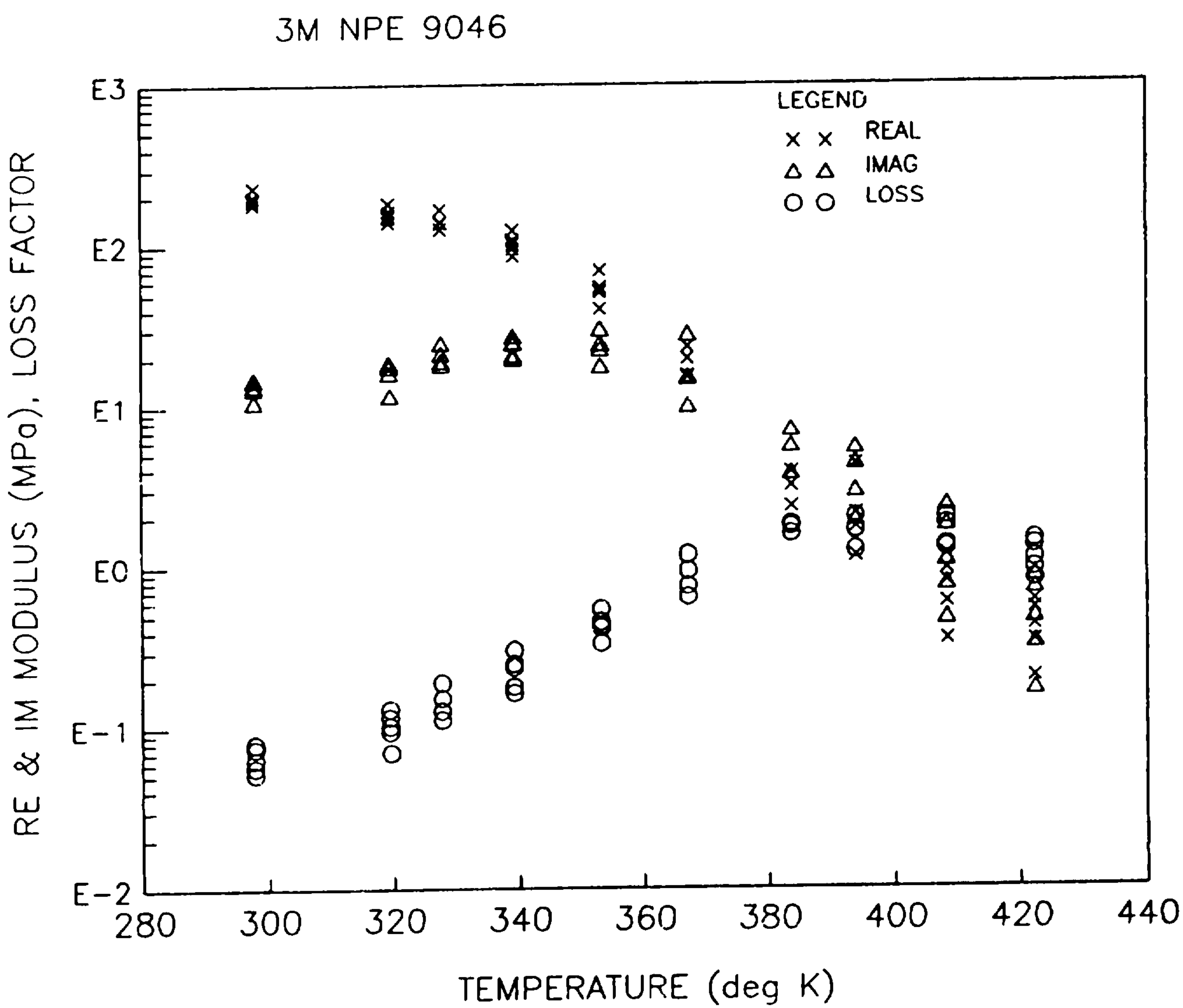

3M NPE 9046
SHEAR
LEGEND
× × REAL
Δ Δ IMAG
○ ○ LOSS
Temperature (deg K)
430
405
385
365
350
335
320
310
300
290
REDUCED FREQUENCY (Hz)
FREQUENCY (Hz)
RE & IM MODULUS (MPa), LOSS FACTOR
E−3
E−2
E−1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
E15


3M NPE 9046
SHEAR
Temperature (deg F)
270 230 200 170 150 130 110 90 80 70
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
E2
E1
E0
E−1
E−2
RE & IM MODULUS (kpsi), LOSS FACTOR
E4
E3
E2
E1
E0
FREQUENCY (Hz)
E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15
REDUCED FREQUENCY (Hz)

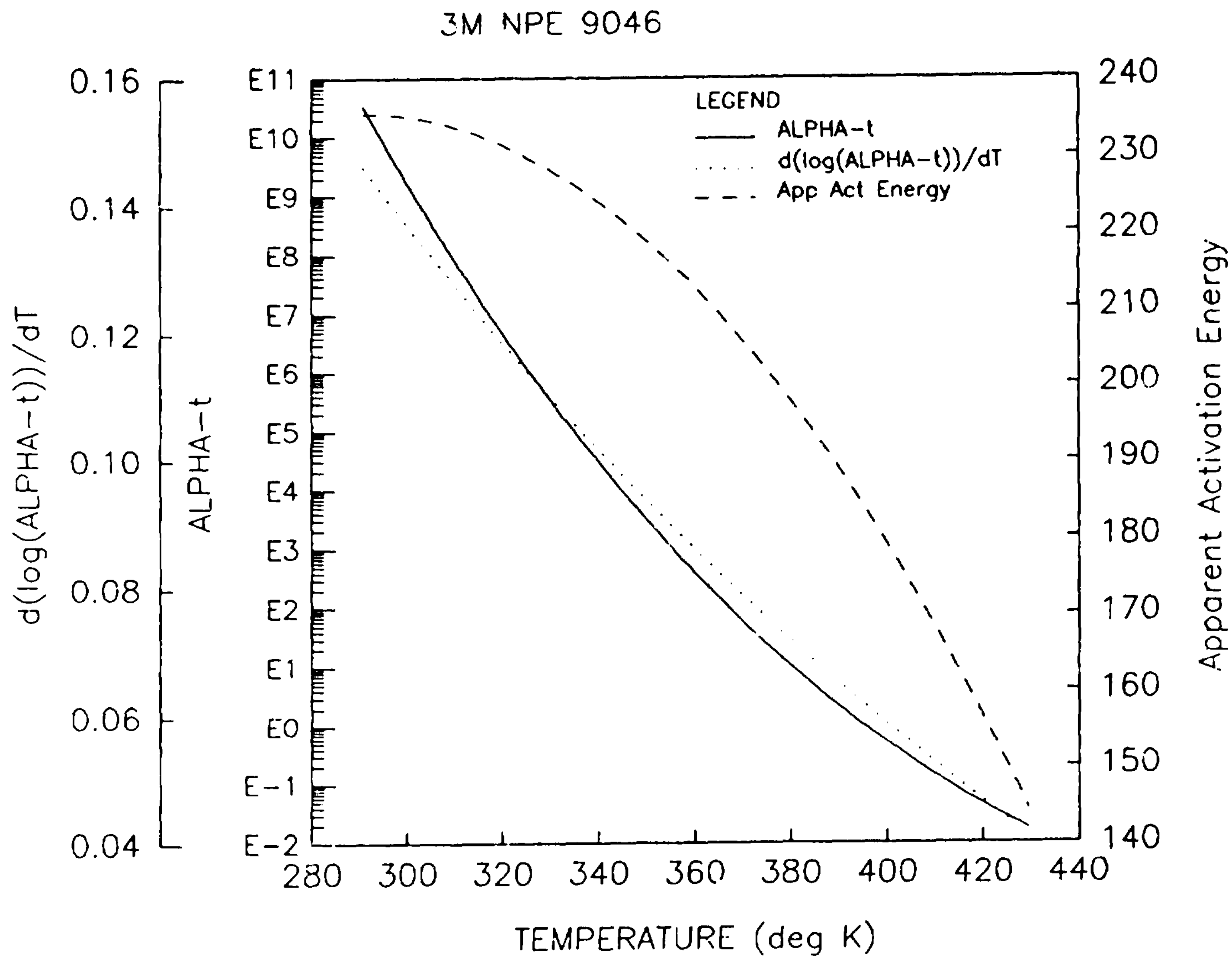

3M NPE 9046
FREQUENCY (Hz)
E4
E3
E2
280
300
320
340
360
380
400
420
440
TEMPERATURE (deg K)
50
100
150
200
250
300
TEMPERATURE (deg F)

3M NPE 9046





3M NPE 9046
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E3
E2
E1
E0
E−1
E−2
280
300
320
340
360
380
400
420
440
TEMPERATURE (deg K)



3M NPE 9046
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.16
0.14
0.12
0.10
0.08
0.06
0.04
ALPHA-t
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
Apparent Activation Energy
240
230
220
210
200
190
180
170
160
150
140
280
300
320
340
360
380
400
420
440
TEMPERATURE (deg K)

3M NPE 9046 SHEAR

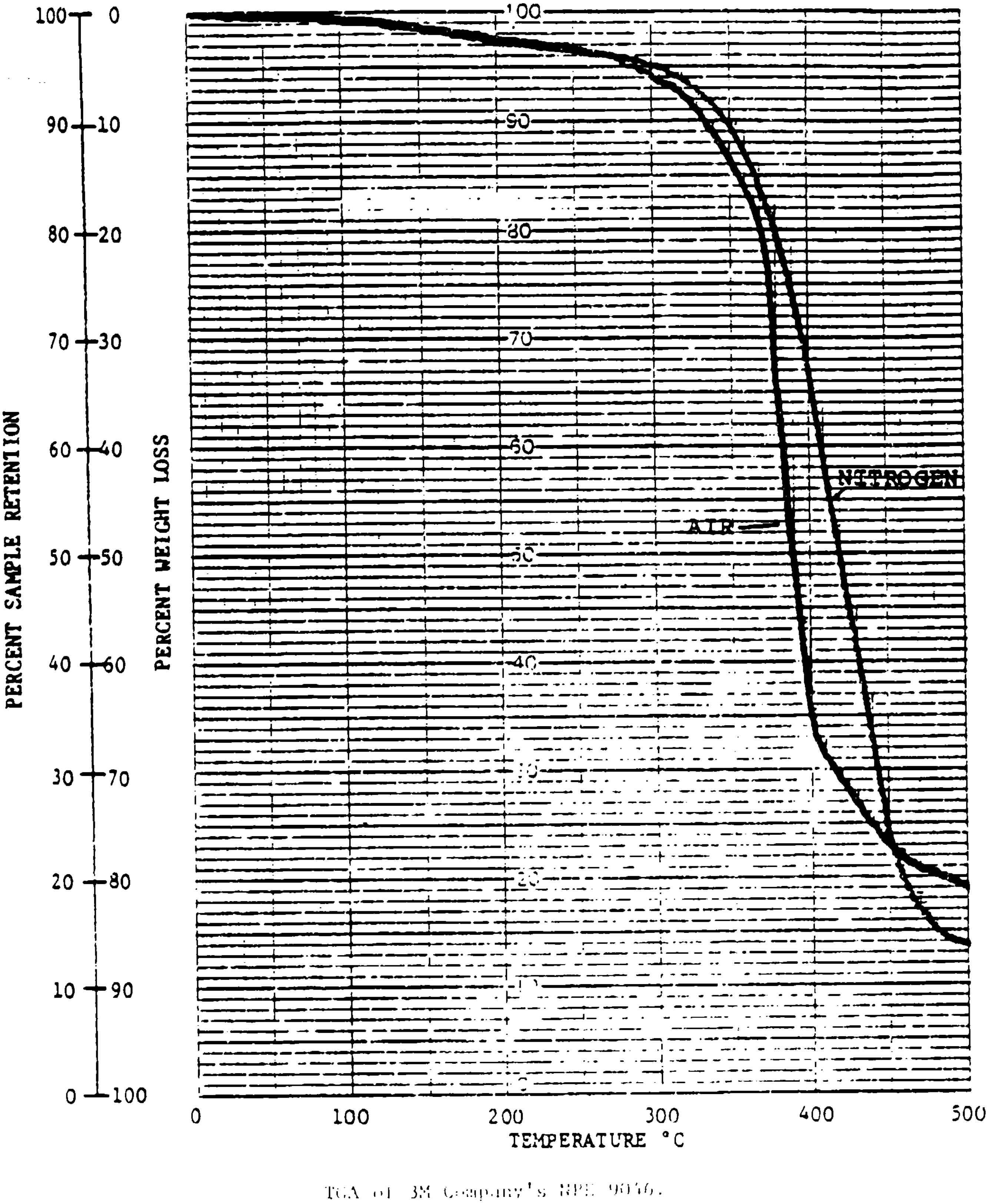
ALFA-T MODEL							
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	395.0	290.0	430.0	0.6178E-01	0.1468	0 4074E-01

COMPLEX MODULUS MODEL							
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.2702E-01	300.0	0.1484E+08	0.4987	1.642	0.1000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
297.7	664.2	179.6	0.8045E-01	14.45
297.7	1810.	190.2	0.7531E-01	14.32
297.7	3442.	199.4	0.6388E-01	12.74
297.7	5556.	233.1	0.5713E-01	13.32
297.7	7890.	201.7	0.5192E-01	10.47
319.3	657.0	138.0	0.1314	18.13
319.3	1779.	147.1	0.1175	17.28
319.3	3362.	153.2	0.1036	15.87
319.3	5418.	182.3	0.9556E-01	17.42
319.4	7645.	161.8	0.7066E-01	11.43
327.6	654.6	125.1	0.1924	24.07
327.6	1769.	135.8	0.1532	20.80
327.6	3330.	138.7	0.1282	17.78
327.6	5353.	165.8	0.1130	18.74
339.1	645.7	85.84	0.3067	26.33
339.1	1728.	94.74	0.2527	23.94
339.1	3236.	101.7	0.2392	24.33
339.1	5171.	122.8	0.1654	20.31
339.1	7200.	106.9	0.1807	19.32
353.0	624.9	40.54	0.5417	21.96
353.0	1654.	52.22	0.4550	23.76
353.0	1642.	51.11	0.3375	17.25
353.0	3019.	54.75	0.4304	23.56
353.0	4827.	69.85	0.4192	29.28
367.0	575.3	15.10	0.6424	9.700
367.0	1452.	15.56	0.9319	14.50
367.0	2613.	19.80	0.7495	14.84
367.0	4179.	23.30	1.166	27.17
383.5	455.7	2.335	1.556	3.633
383.5	1143.	3.137	1.720	5.396
383.5	2058.	3.808	1.796	6.839
393.7	1033.	1.715	1.643	2.818
393.7	1914.	2.102	2.000	4.204
393.7	3182.	4.237	1.238	5.245
408.2	348.2	0.3543	1.301	0.4609
408.2	929.1	0.5918	1.269	0.7510
408.2	1779.	0.8033	1.315	1.056
408.2	2910.	0.9563	1.789	1.711
408.2	4331.	1.157	1.983	2.294
422.2	331.3	0.2036	0.8167	0.1663

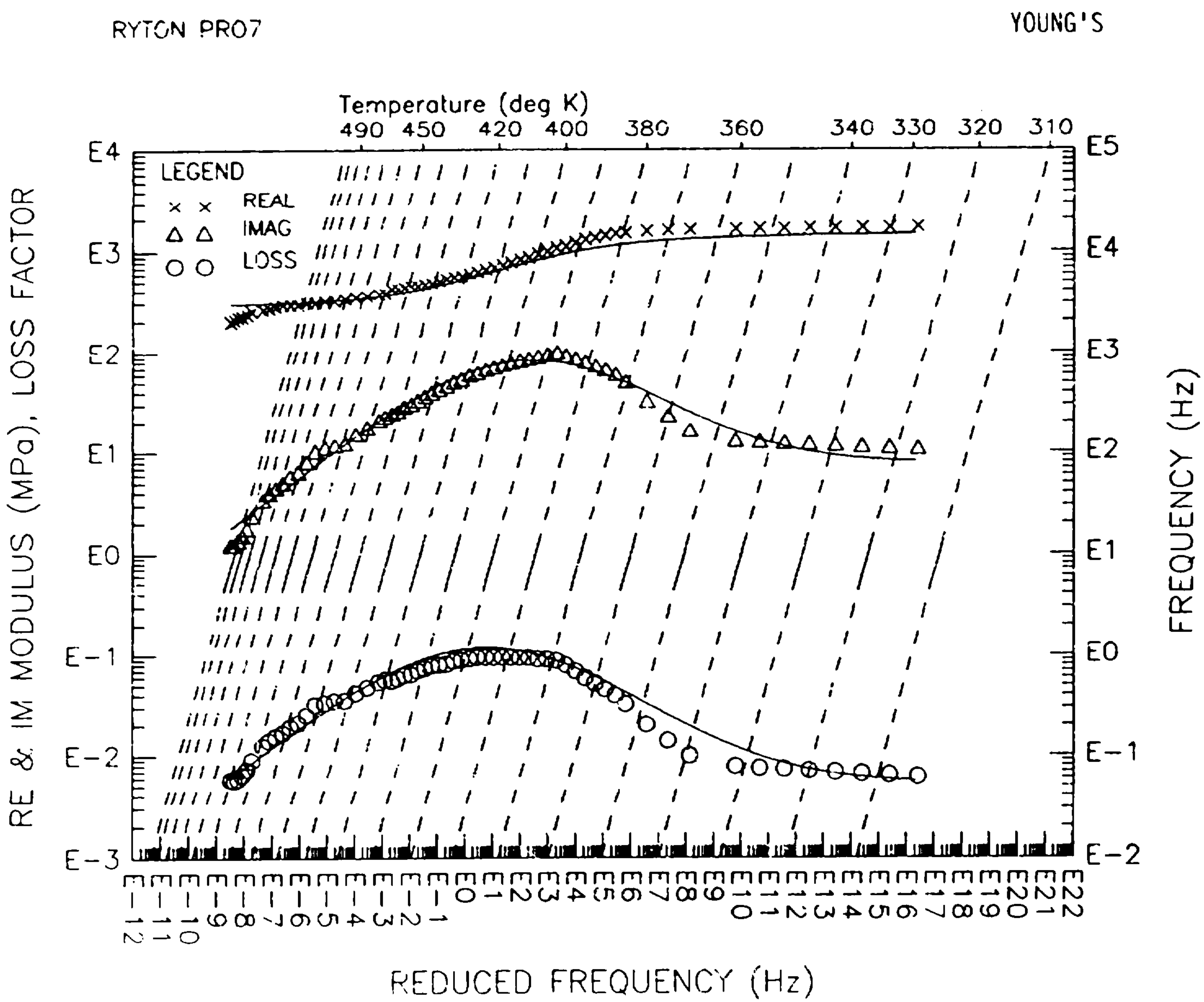
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
422.2	898.6	0.3438	0.9509	0.3269
422.2	1740.	0.4267	1.092	0.4660
422.2	2862.	0.5400	1.307	0.7058
393.7	405.2	1.141	1.623	1.852
422.2	4264.	0.6006	1.409	0.8462



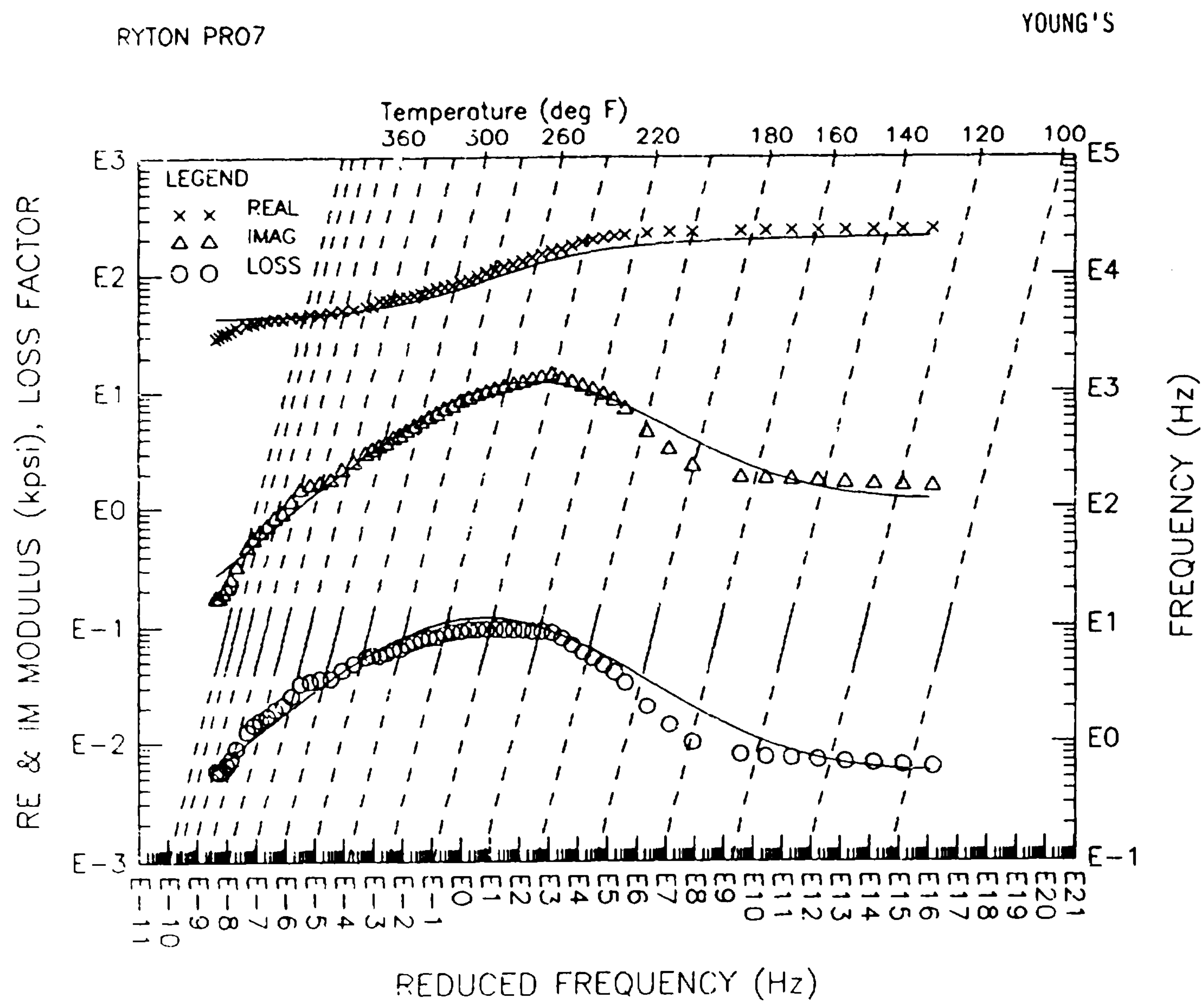
TGA of 3M Company's RPE 9046.

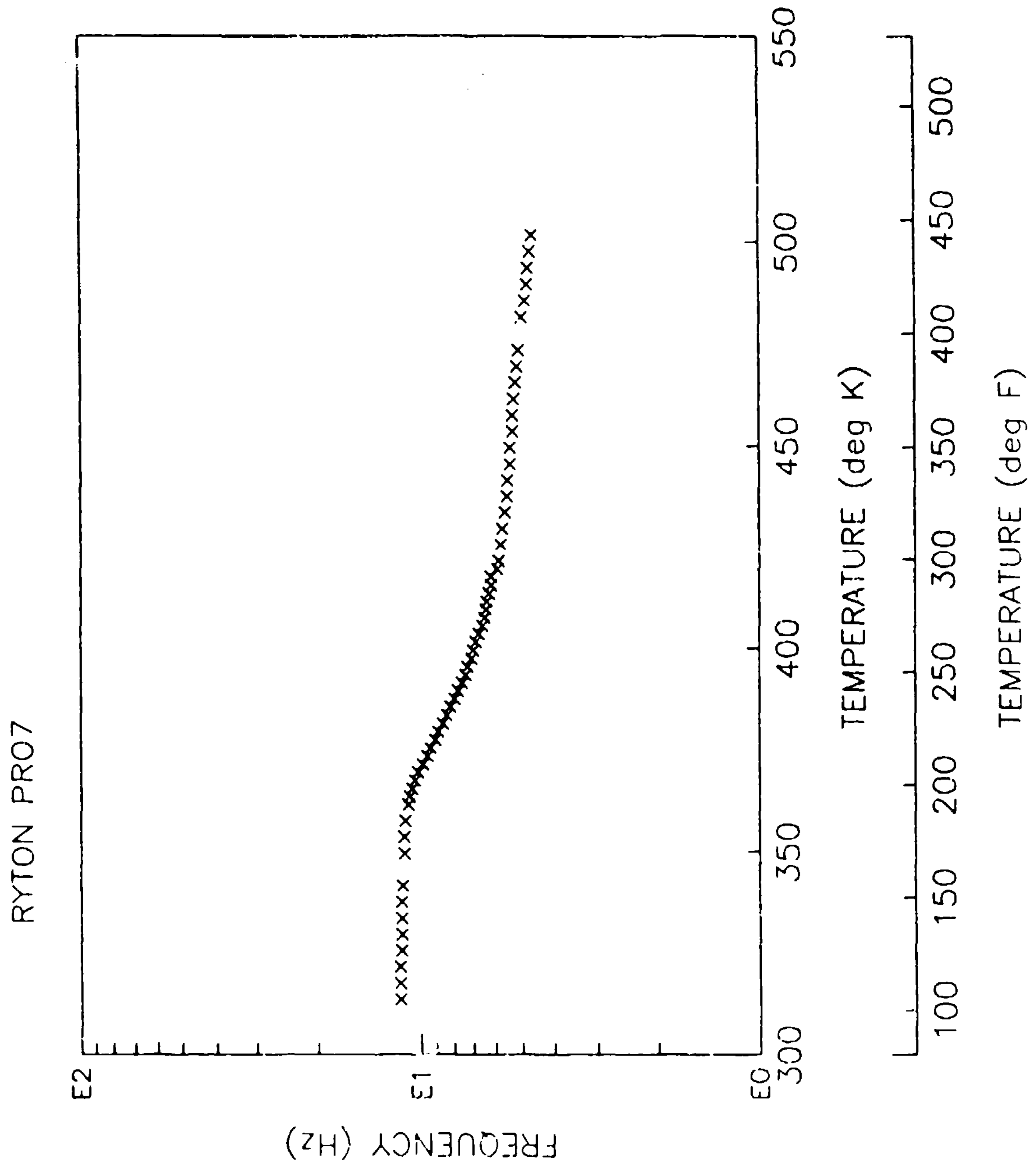
RYTON PRO7 YOUNG'S

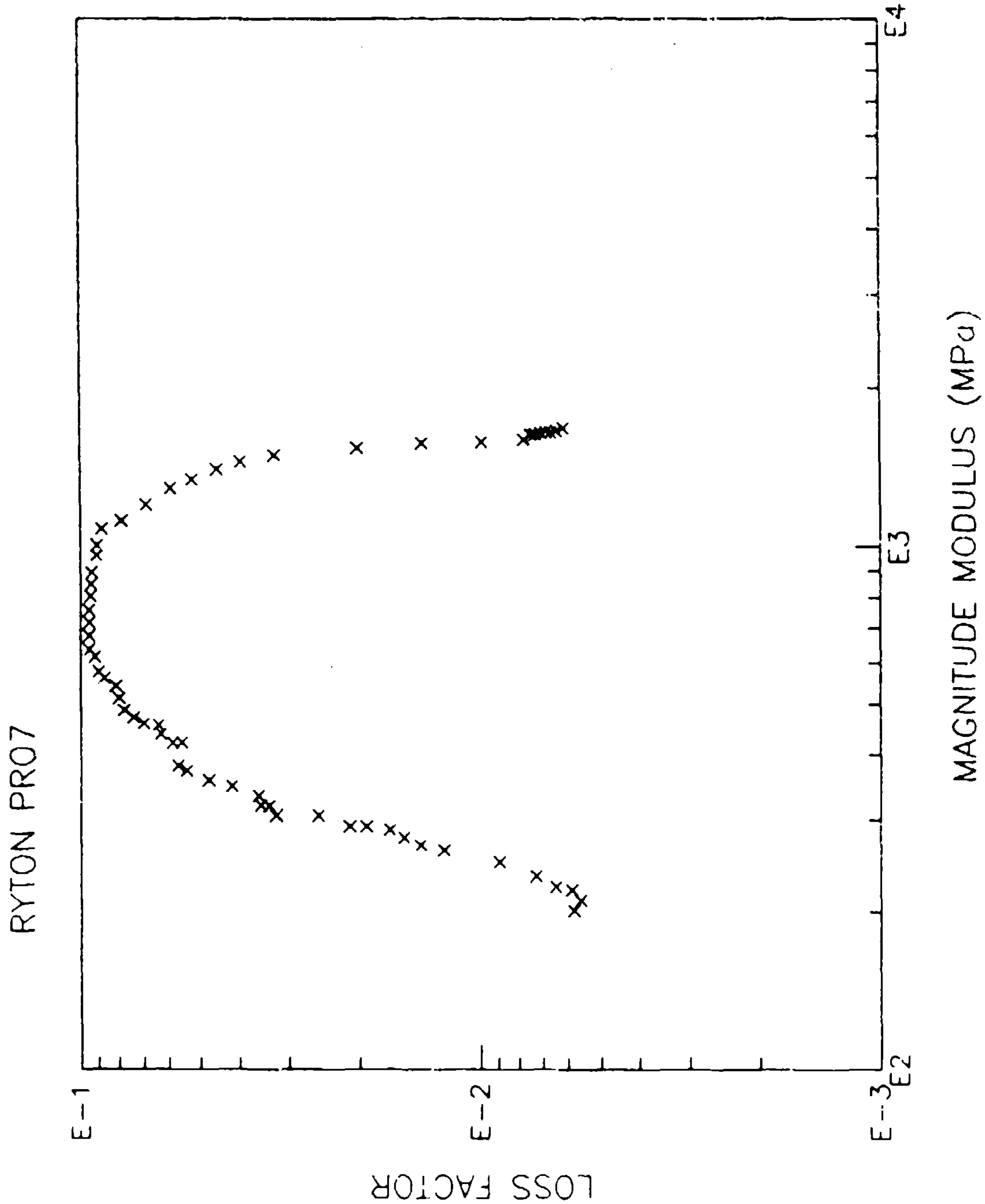
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.5640E-02	0.8315E-01	0.1188	0.8315E-01	0.5995E-02
MODULUS	MPA	1428.	960.6	606.6	404.3	295.2
	PSI	0.2071E+06	0.1393E+06	0.8798E+05	0.5864E+05	0.4281E+05
10.HZ	DEG K		373.0	392.0	412.0	
	DEG C		79.85	98.85	118.9	
	DEG F		175.7	209.9	245.9	
100.HZ	DEG K		379.0	399.0	421.0	
	DEG C		85.85	105.9	127.9	
	DEG F		186.5	222.5	262.1	
1000.HZ	DEG K		386.0	407.0	431.0	
	DEG C		92.85	113.9	137.9	
	DEG F		199.1	236.9	280.1	

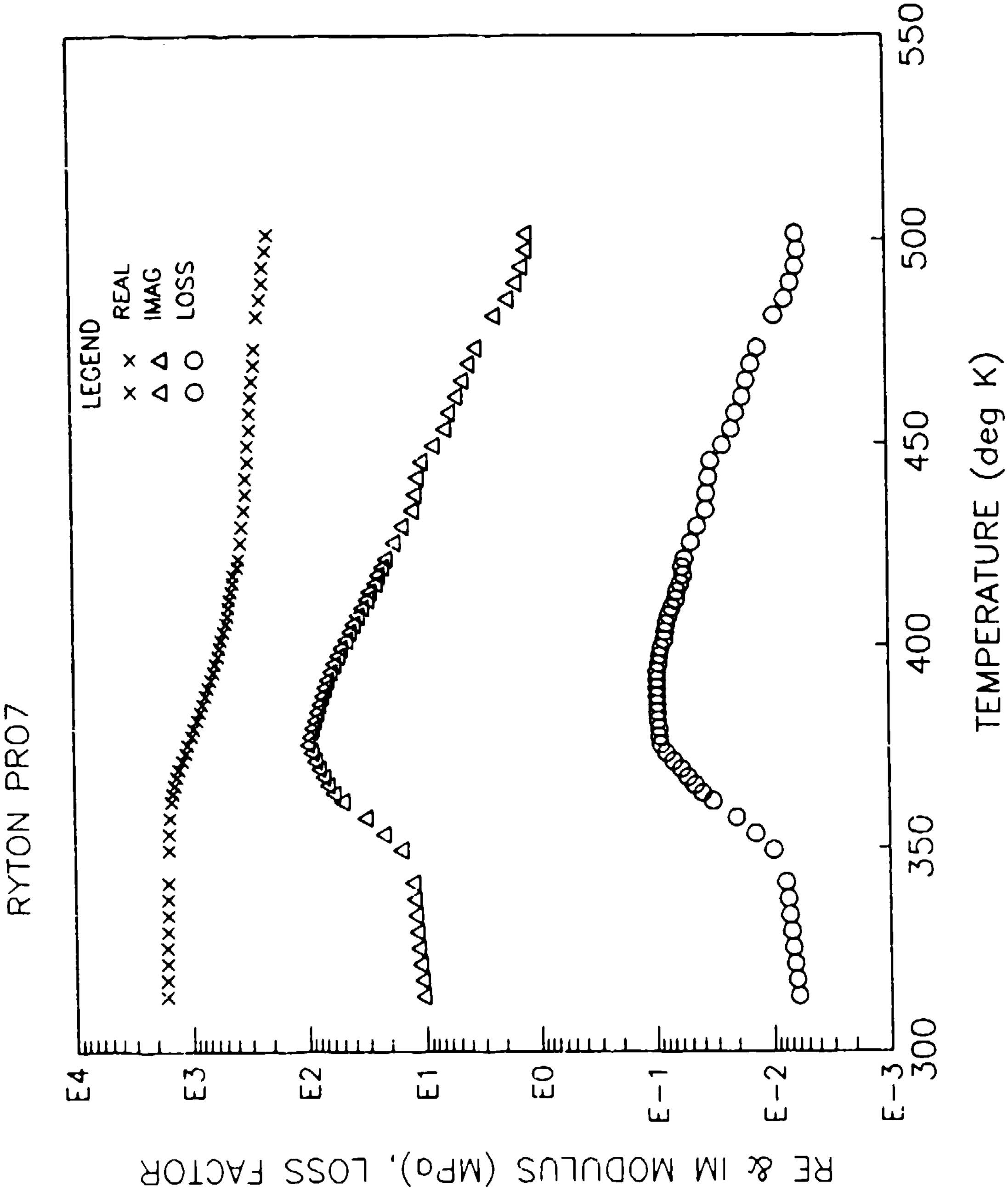


RYTON PRO7
YOUNG'S
Temperature (deg K)
490 450 420 400 380 360 340 330 320 310
LEGEND
REAL
IMAG
LOSS
E4
E3
E2
E1
E0
E−1
E−2
E−3
E5
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)

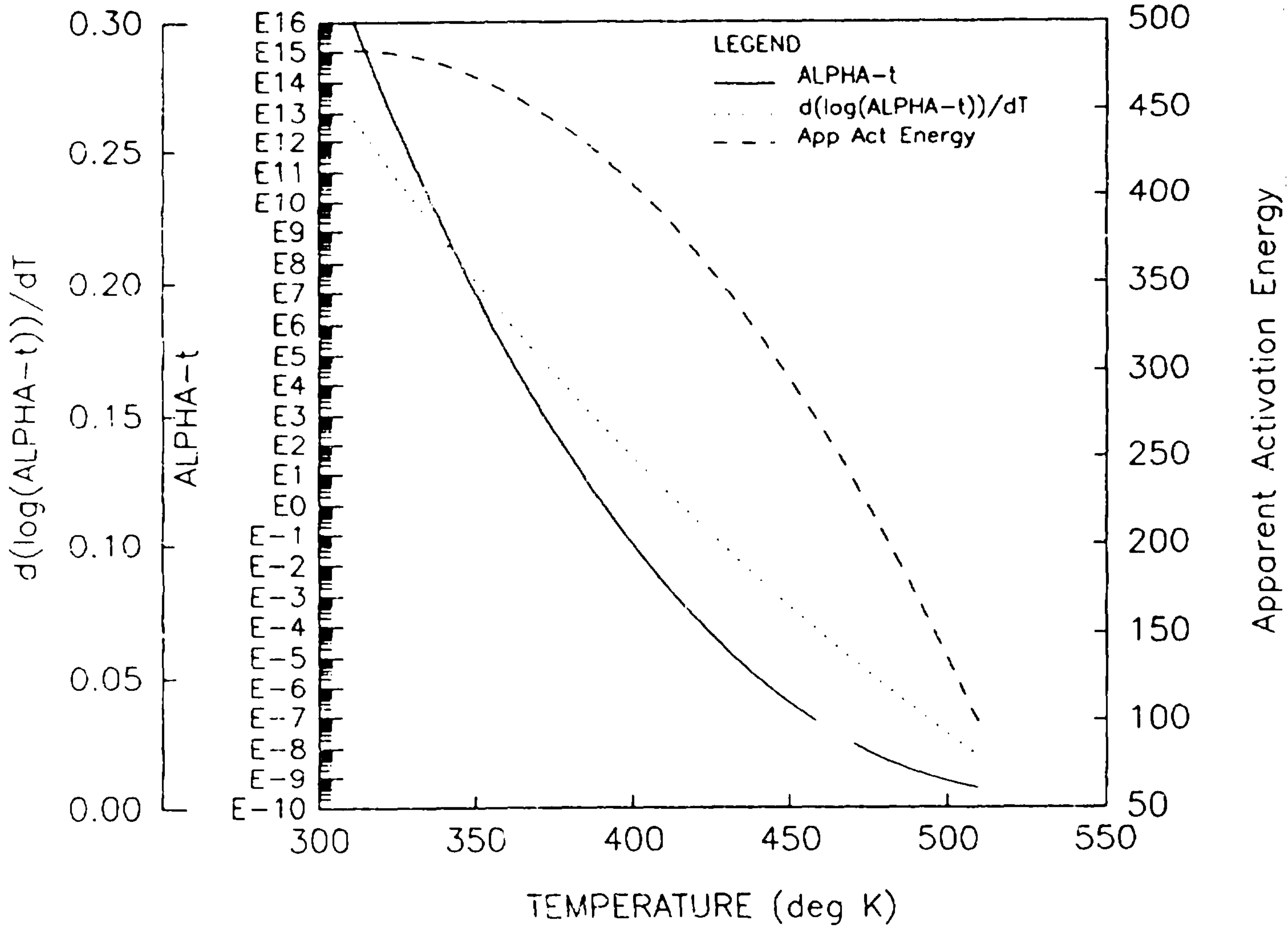

RYTON PRO7
YOUNG'S
Temperature (deg F)
360
300
260
220
180
160
140
120
100
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)
E3
E2
E1
E0
E−1
E−2
E−3
E5
E4
E3
E2
E1
E0
E−1
E−11
E−10
E−9
E−8
E−7
E−6
E−5
E−4
E−3
E−2
E−1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
E15
E16
E17
E18
E19
E20
E21


RYTON PRO7
FREQUENCY (Hz)
E2
E1
E0
300
350
400
450
500
550
TEMPERATURE (deg K)
100
150
200
250
300
350
400
450
500
TEMPERATURE (deg F)


RYTON PR07
LOSS FACTOR
E-1
E-2
E-3
E2
E3
E4
MAGNITUDE MODULUS (MPa)


RYTON PR07
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
E-1
E-2
E-3
TEMPERATURE (deg K)
300
350
400
450
500
550

RYTON PRO7



LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
0.30
0.25
0.20
0.15
0.10
0.05
0.00
d(log(ALPHA-t))/dT
ALPHA-t
E16
E15
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
E-5
E-6
E-7
E-8
E-9
E-10
500
450
400
350
300
250
200
150
100
50
Apparent Activation Energy
300
350
400
450
500
550
TEMPERATURE (deg K)

RYTON PRO7 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	390.0	310.0	510.0	0.1453	0.2638	0.1929E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
[illegible]	6	290.0	4287.	0.1753E+06	0.2100	3.207	0.5800E-02

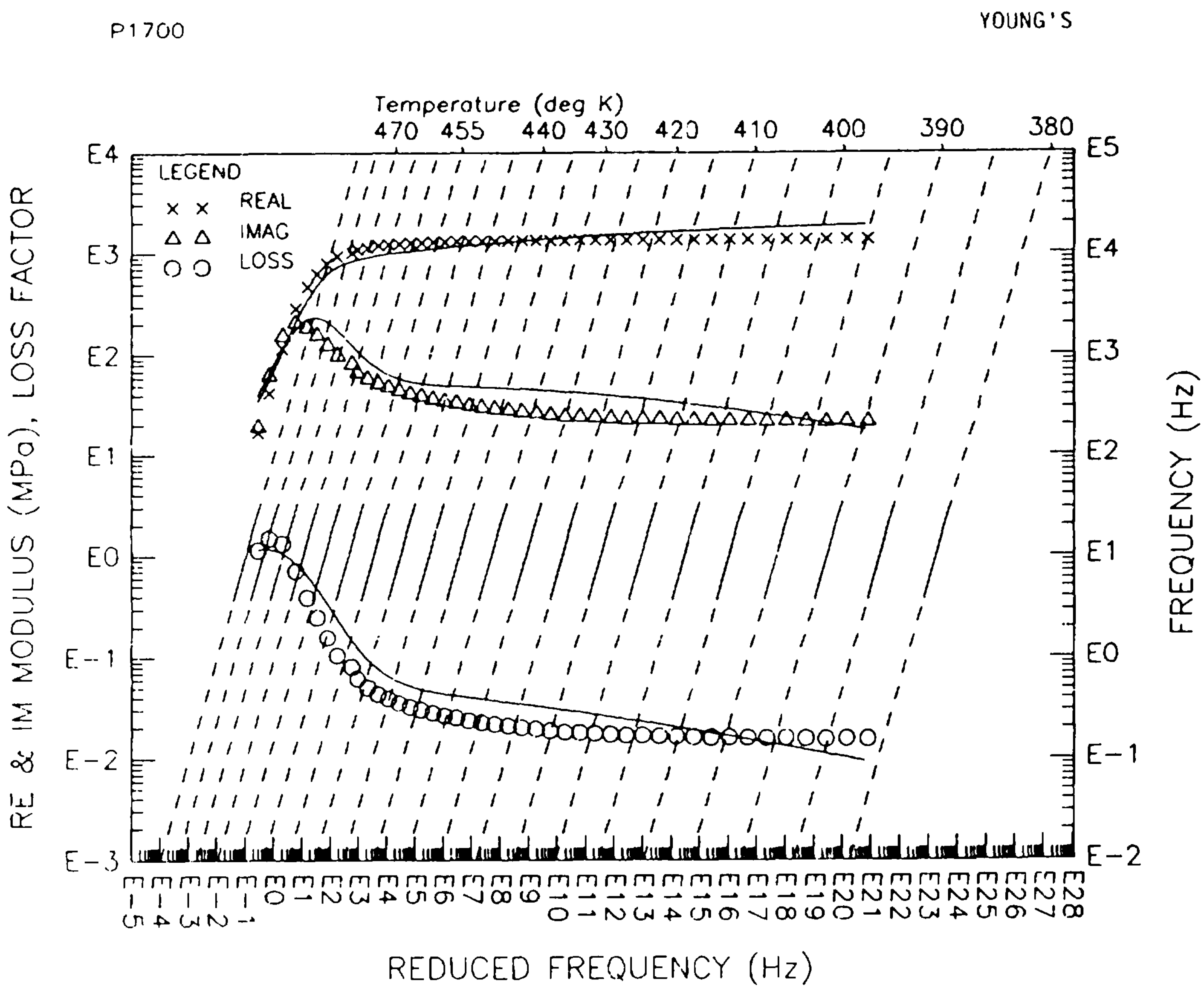
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
313.2	11.80	1670.	0.6150E-02	10.27
317.2	11.50	1650.	0.6390E-02	10.54
321.2	11.60	1640.	0.6600E-02	10.82
325.2	11.40	1640.	0.6820E-02	11.18
329.2	11.40	1630.	0.7040E-02	11.48
333.2	11.40	1620.	0.7270E-02	11.78
337.2	11.40	1620.	0.7470E-02	12.10
341.2	11.30	1590.	0.7780E-02	12.37
349.2	11.20	1570.	0.9860E-02	15.48
353.2	11.20	1560.	0.1390E-01	21.68
357.2	11.10	1530.	0.2020E-01	30.91
361.2	10.90	1480.	0.3240E-01	47.95
363.2	10.80	1440.	0.3960E-01	57.02
365.2	10.60	1390.	0.4560E-01	63.38
367.2	10.40	1330.	0.5230E-01	69.56
369.2	10.20	1280.	0.5930E-01	75.90
371.2	9.840	1190.	0.6900E-01	82.11
373.2	9.540	1110.	0.7920E-01	87.91
373.2	9.540	1110.	0.7920E-01	87.91
375.2	9.350	1070.	0.8840E-01	94.59
377.2	9.050	994.0	0.9080E-01	90.26
379.2	8.860	950.0	0.9100E-01	86.45
381.2	8.560	881.0	0.9360E-01	82.46
383.2	8.360	837.0	0.9390E-01	78.59
385.2	8.160	794.0	0.9430E-01	74.87
387.2	7.940	746.0	0.9510E-01	70.94
389.2	7.750	707.0	0.9500E-01	67.17
391.2	7.550	667.0	0.9500E-01	63.36
393.2	7.350	628.0	0.9490E-01	59.60
395.2	7.250	609.0	0.9200E-01	56.03
397.2	7.050	571.0	0.8980E-01	51.28
399.2	6.960	555.0	0.8700E-01	48.28
401.2	6.860	537.0	0.8160E-01	43.82
403.2	6.700	508.0	0.8010E-01	40.69
405.2	6.550	482.0	0.7800E-01	37.60
407.2	6.460	467.0	0.7420E-01	34.65
409.2	6.390	455.0	0.6990E-01	31.80
411.2	6.360	451.0	0.6430E-01	29.00
413.2	6.260	434.0	0.6320E-01	27.43
415.2	6.160	418.0	0.5880E-01	24.58

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
417.2	6.160	418.0	0.5550E-01	23.20
419.2	5.910	378.0	0.5680E-01	21.47
421.2	5.860	370.0	0.5410E-01	20.02
425.2	5.760	355.0	0.4780E-01	16.97
429.2	5.700	346.0	0.4200E-01	14.53
433.2	5.600	331.0	0.3560E-01	11.78
437.2	5.510	318.0	0.3510E-01	11.16
441.2	5.510	318.0	0.3350E-01	10.65
445.2	5.410	304.0	0.3220E-01	9.789
449.2	5.410	304.0	0.2540E-01	7.722
453.2	5.310	290.0	0.2110E-01	6.119
457.2	5.310	290.0	0.1930E-01	5.597
461.2	5.280	285.0	0.1690E-01	4.816
465.2	5.210	276.0	0.1550E-01	4.278
469.2	5.140	266.0	0.1410E-01	3.751
473.2	5.100	261.0	0.1240E-01	3.236
481.2	5.000	248.0	0.8930E-02	2.215
485.2	4.890	233.0	0.7270E-02	1.694
489.2	4.800	222.0	0.6460E-02	1.434
493.2	4.780	219.0	0.5870E-02	1.286
497.2	4.700	209.0	0.5610E-02	1.172
501.2	4.630	200.0	0.5800E-02	1.160

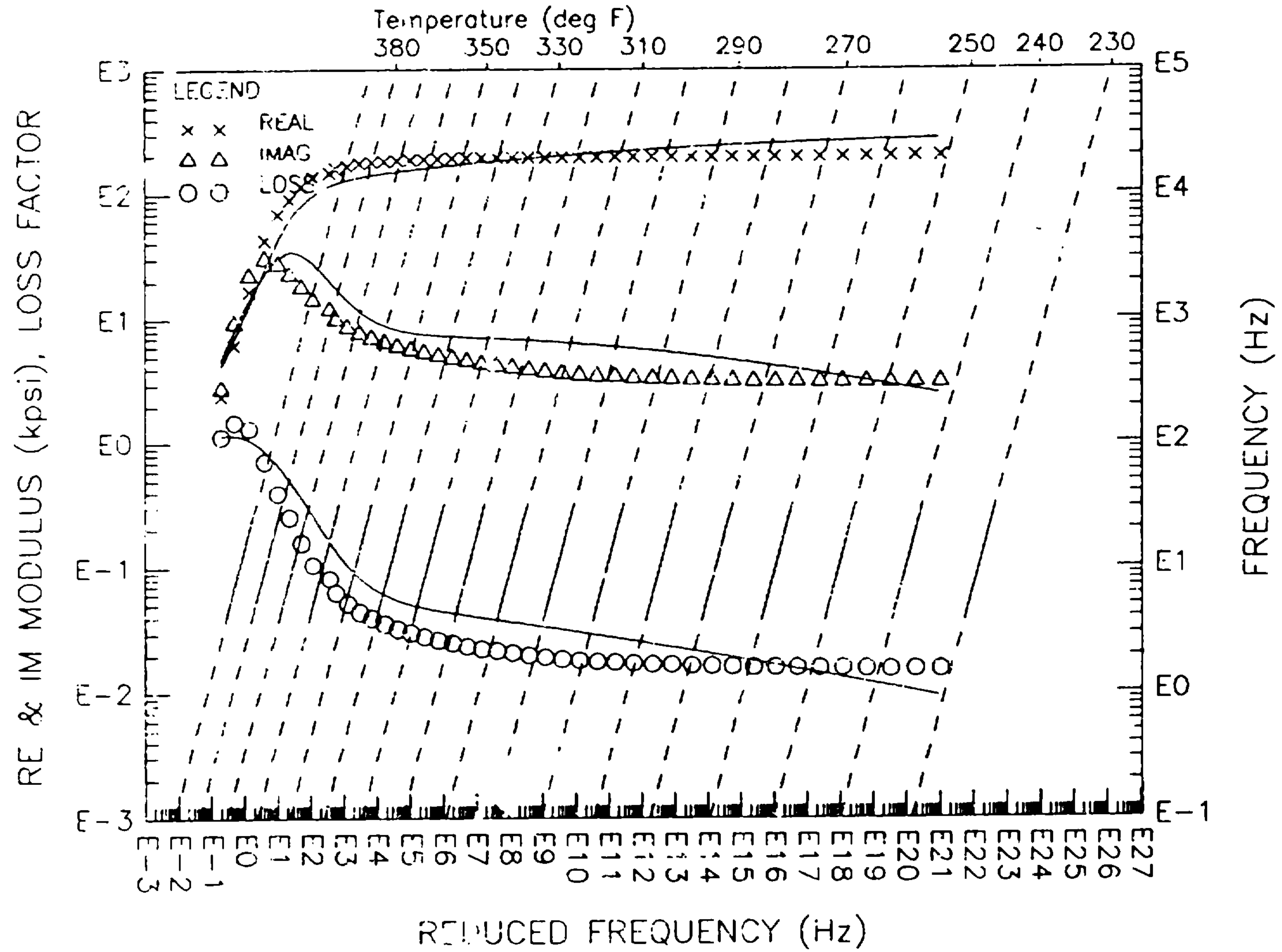
P1700 YOUNG'S

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.9269E-02	0.8119	1.160	0.8119	1.145
MODULUS	MPA	1900.	247.3	44.14	21.19	34.39
	PSI	0.2756E+06	0.3587E+05	6401.	3073.	4987.
10.HZ	DEG K		466.0	475.0	480.0	
	DEG C		172.9	181.9	186.9	
	DEG F		343.1	359.3	368.3	
100.HZ	DEG K		473.0	480.0	0.0000E+00	
	DEG C		179.9	186.9	-293.1	
	DEG F		355.7	368.3	-495.7	
1000.HZ	DEG K		480.0	480.0	0.0000E+00	
	DEG C		186.9	186.9	-293.1	
	DEG F		368.3	368.3	-495.7	

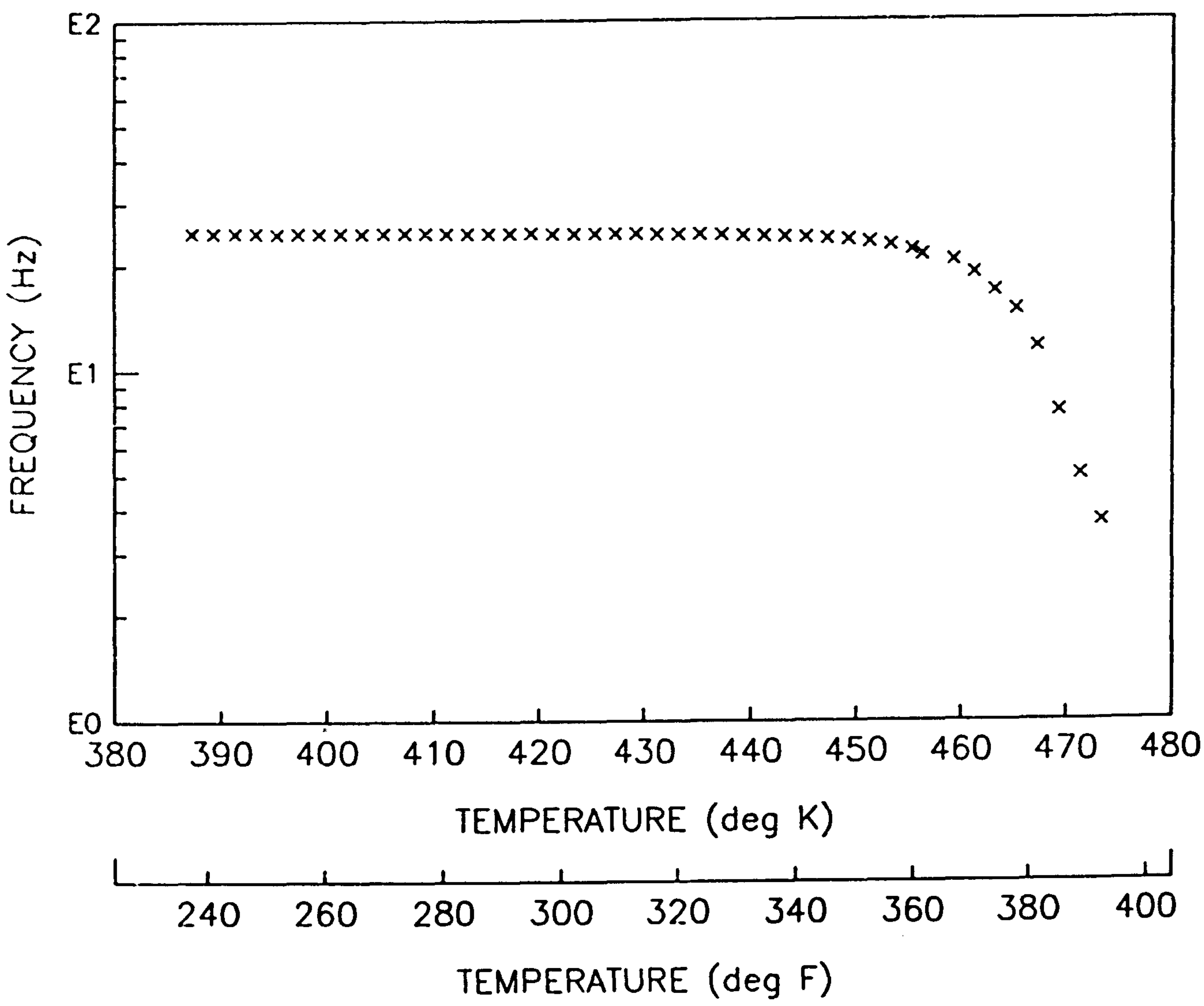

P1700
YOUNG'S
Temperature (deg K)
470 455 440 430 420 410 400 390 380
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4 E3 E2 E1 E0 E−1 E−2 E−3
FREQUENCY (Hz)
E5 E4 E3 E2 E1 E0 E−1 E−2
REDUCED FREQUENCY (Hz)
E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28

P1700

YOUNG'S

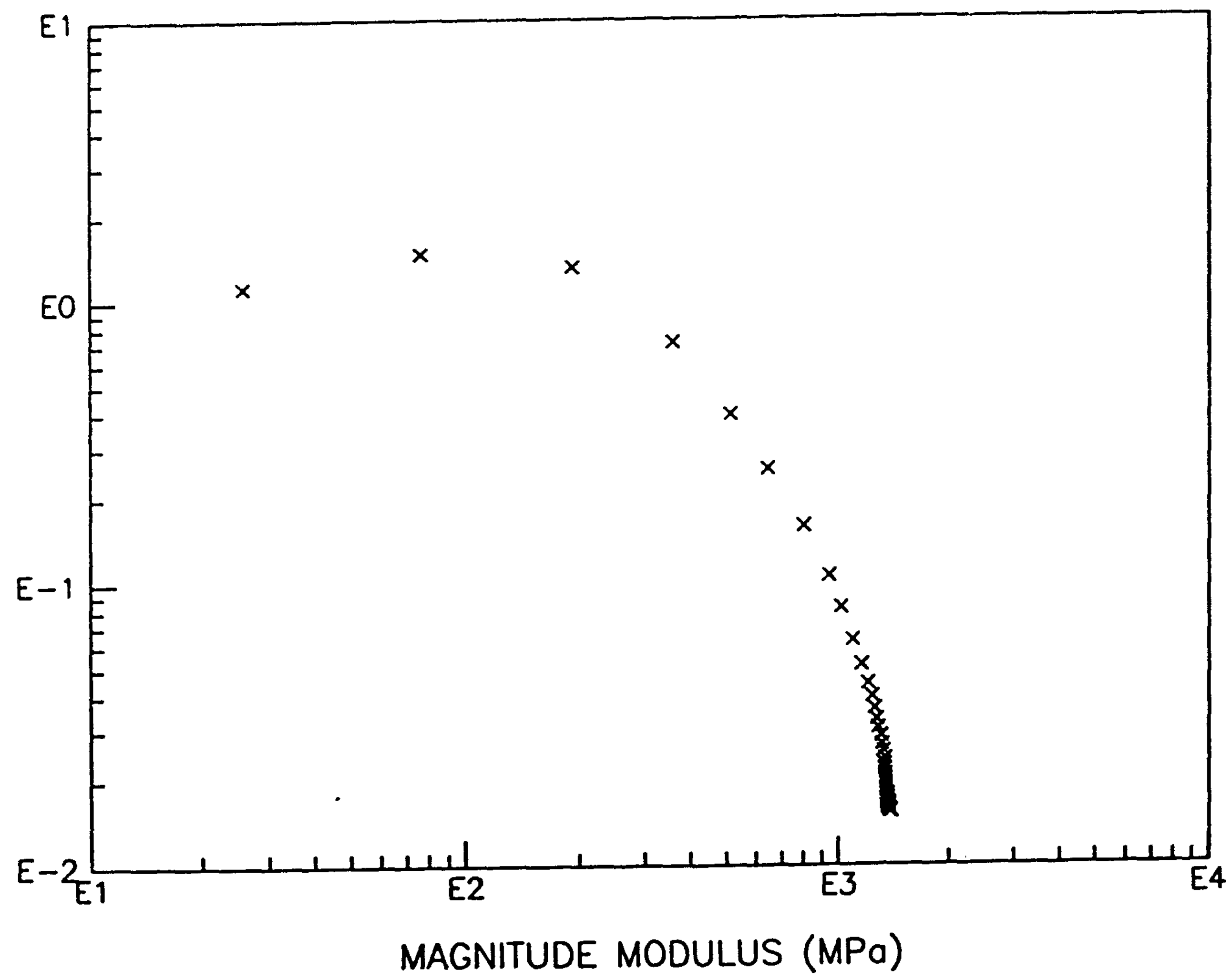


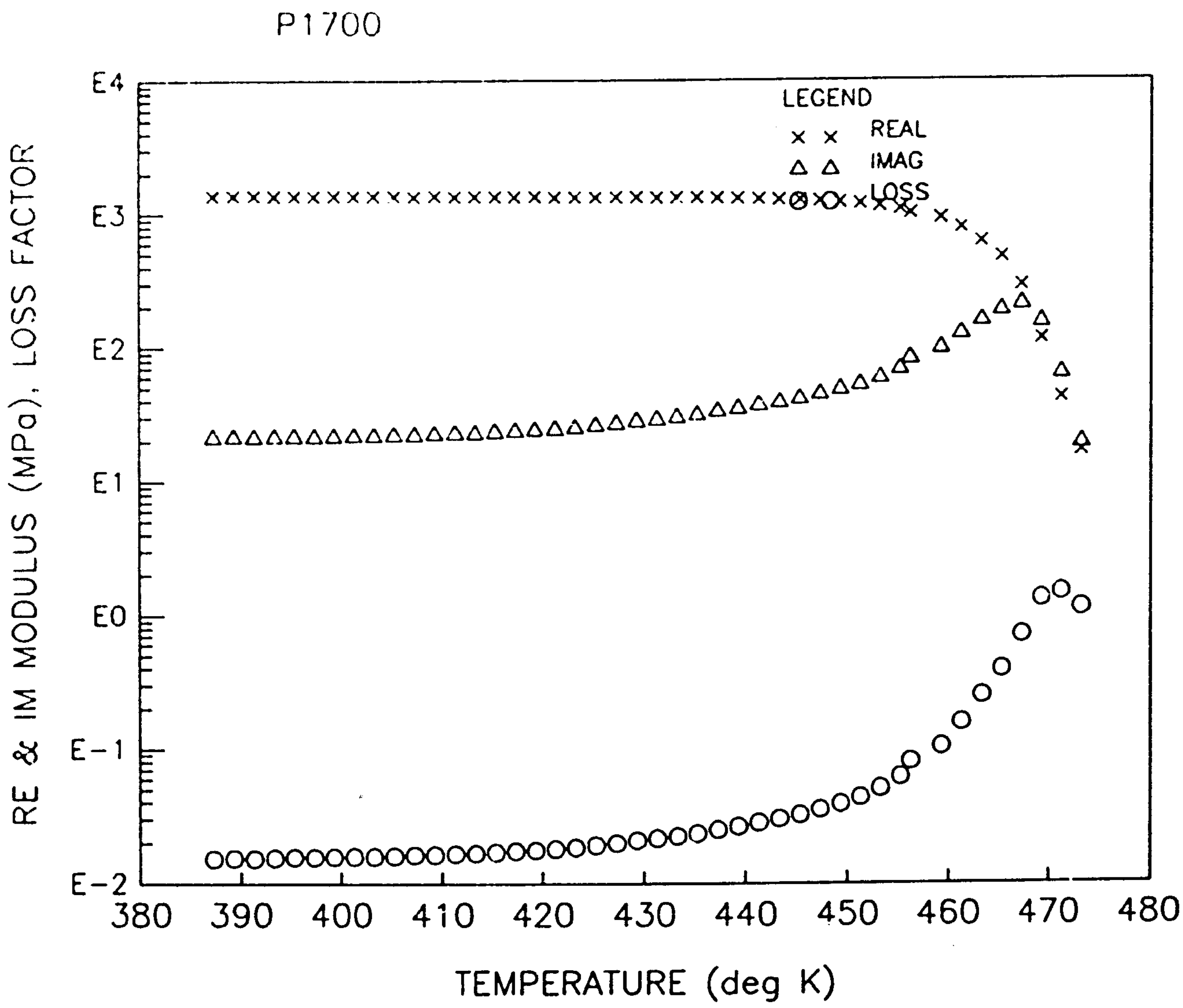
P1700

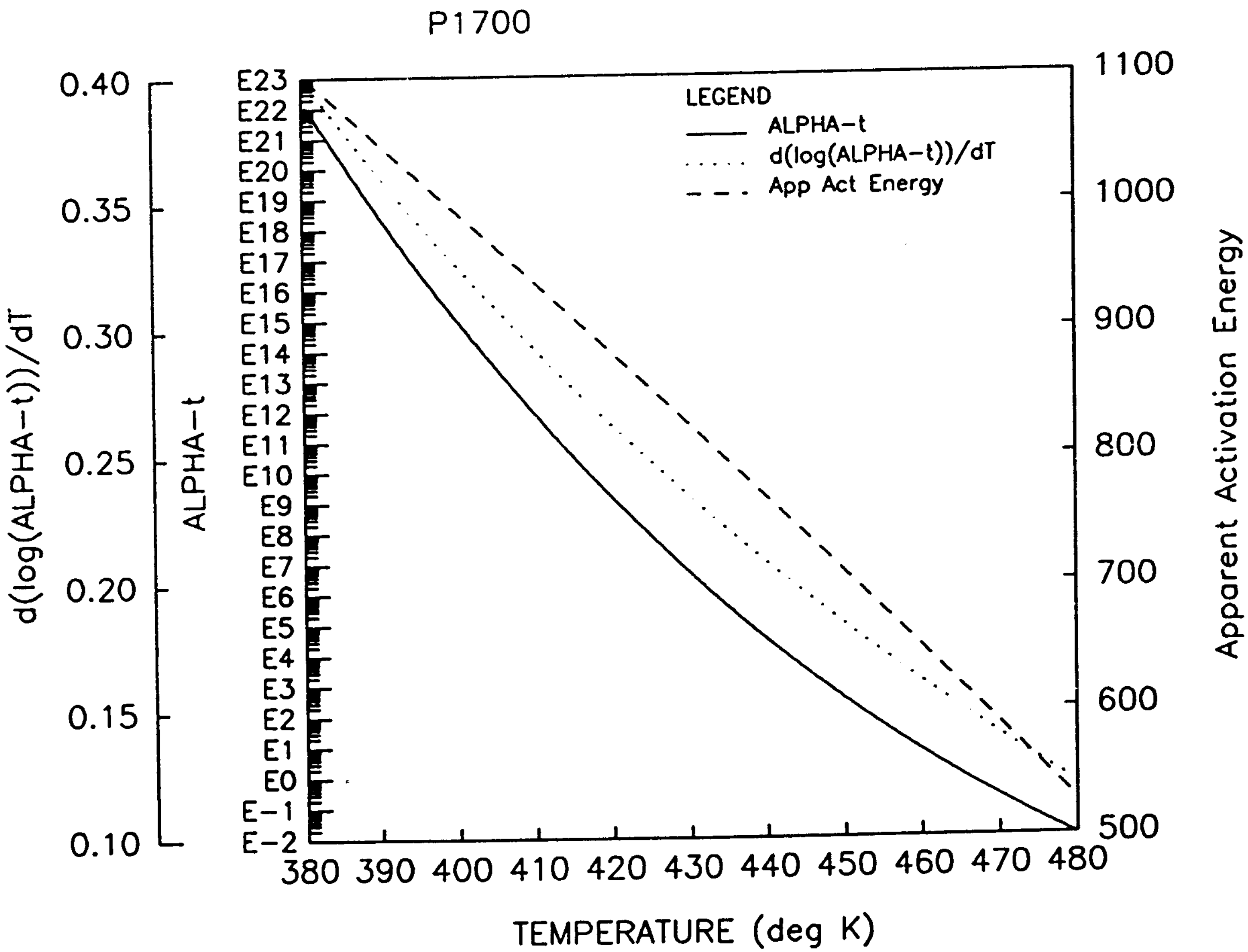


E2
E1
E0
FREQUENCY (Hz)
380 390 400 410 420 430 440 450 460 470 480
TEMPERATURE (deg K)
240 260 280 300 320 340 360 380 400
TEMPERATURE (deg F)

P1700




P1700
LEGEND
REAL
IMAG
LOSS
E4
E3
E2
E1
E0
E−1
E−2
RE & IM MODULUS (MPa), LOSS FACTOR
380
390
400
410
420
430
440
450
460
470
480
TEMPERATURE (deg K)


P1700
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.40
0.35
0.30
0.25
0.20
0.15
0.10
ALPHA-t
E23
E22
E21
E20
E19
E18
E17
E16
E15
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
380 390 400 410 420 430 440 450 460 470 480
TEMPERATURE (deg K)
Apparent Activation Energy
1100
1000
900
800
700
600
500

P1700 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	465.0	380.0	480.0	0.1500	0.4000	0.1200

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	7.000	2100.	80.00	0.6500	1.500	0.6000E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

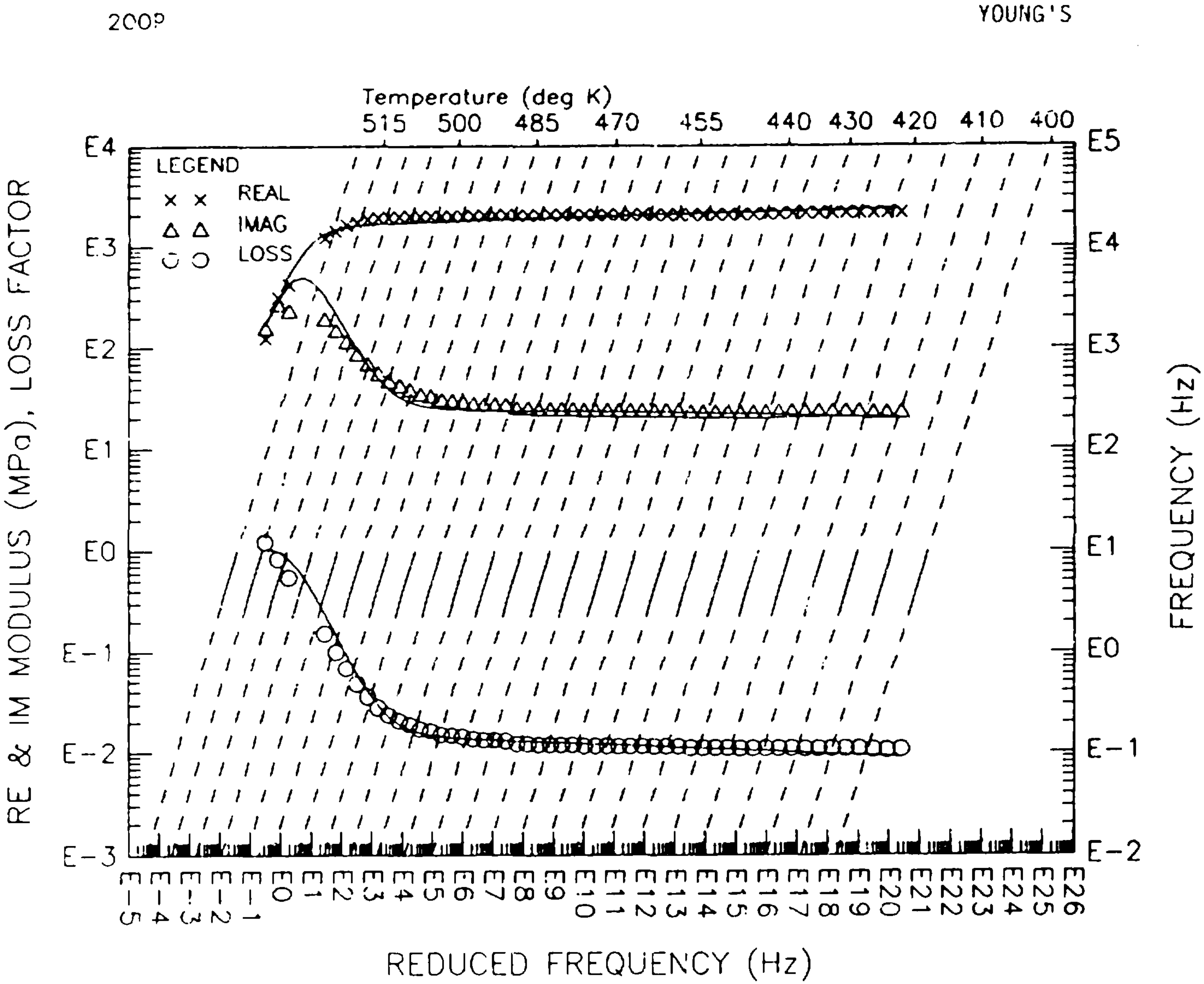
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
387.2	24.80	1380.	0.1540E-01	21.25
389.2	24.80	1380.	0.1550E-01	21.39
391.2	24.80	1380.	0.1540E-01	21.25
393.2	24.80	1370.	0.1560E-01	21.37
395.2	24.70	1360.	0.1580E-01	21.49
397.2	24.70	1360.	0.1580E-01	21.49
399.2	24.70	1360.	0.1590E-01	21.62
401.2	24.70	1360.	0.1600E-01	21.76
403.2	24.70	1360.	0.1600E-01	21.76
405.2	24.70	1360.	0.1620E-01	22.03
407.2	24.70	1350.	0.1640E-01	22.14
409.2	24.70	1360.	0.1650E-01	22.44
411.2	24.60	1350.	0.1680E-01	22.68
413.2	24.60	1350.	0.1690E-01	22.81
415.2	24.60	1350.	0.1720E-01	23.22
417.2	24.60	1350.	0.1760E-01	23.76
419.2	24.60	1350.	0.1780E-01	24.03
421.2	24.50	1340.	0.1820E-01	24.39
423.2	24.50	1340.	0.1870E-01	25.06
425.2	24.50	1340.	0.1940E-01	26.00
427.2	24.50	1340.	0.2010E-01	26.93
429.2	24.50	1340.	0.2100E-01	28.14
431.2	24.40	1330.	0.2180E-01	28.99
433.2	24.40	1330.	0.2260E-01	30.06
435.2	24.40	1330.	0.2370E-01	31.52
437.2	24.30	1320.	0.2520E-01	33.26
439.2	24.20	1310.	0.2660E-01	34.85
441.2	24.10	1300.	0.2840E-01	36.92
443.2	24.00	1280.	0.3040E-01	38.91
445.2	23.90	1270.	0.3250E-01	41.27
447.2	23.70	1250.	0.3560E-01	44.50
449.2	23.50	1230.	0.3930E-01	48.34
451.2	23.20	1200.	0.4370E-01	52.44
453.2	22.70	1150.	0.5110E-01	58.76
455.2	22.10	1090.	0.6230E-01	67.91
456.2	21.30	1010.	0.8130E-01	82.11
459.2	20.50	935.0	0.1050	98.17
461.2	18.90	791.0	0.1580	125.0
463.2	16.80	623.0	0.2520	157.0
465.2	14.80	477.0	0.3940	187.9

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
467.2	11.60	291.0	0.7140	207.8
469.2	7.590	116.0	1.320	153.1
471.2	5.000	42.60	1.480	63.05
473.2	3.690	16.90	1.130	19.10

200 P

YOUNG'S

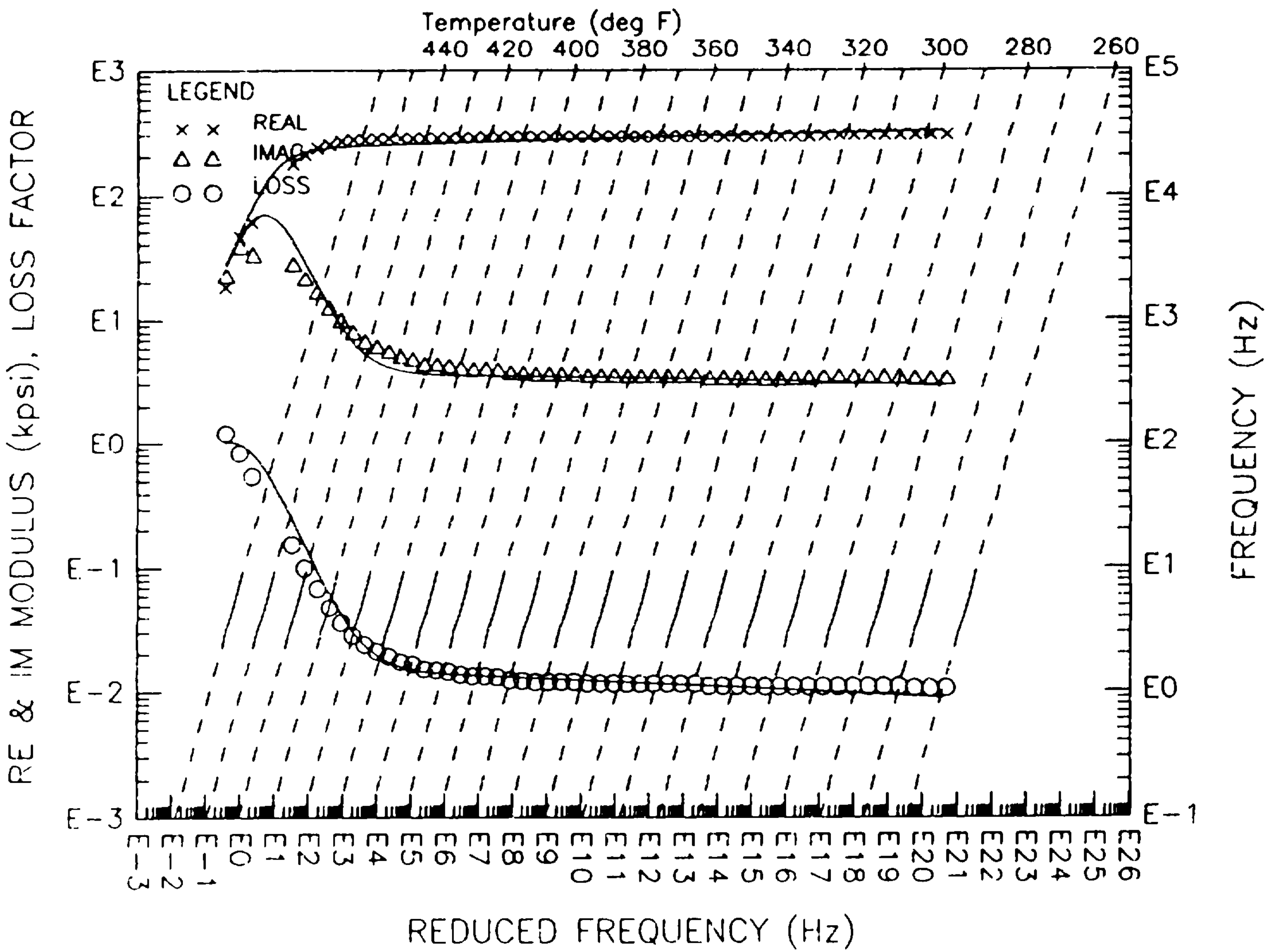
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.8942E-02	0.7118	1.017	0.7118	1.017
MODULUS	MPA	2249.	696.0	184.2	95.42	170.3
	PSI	0.3262E+06	0.1009E+06	0.2672E+05	0.1384E+05	0.2470E+05
	DEG K		508.0	514.0	518.0	
10.HZ	DEG C		214.9	220.9	224.9	
	DEG F		418.7	429.5	436.7	
	DEG K		514.0	520.0	0.0000E+00	
100.HZ	DEG C		220.9	226.9	-293.1	
	DEG F		429.5	440.3	-495.7	
	DEG K		520.0	520.0	0.0000E+00	
1000.HZ	DEG C		226.9	226.9	-293.1	
	DEG F		440.3	440.3	-495.7	

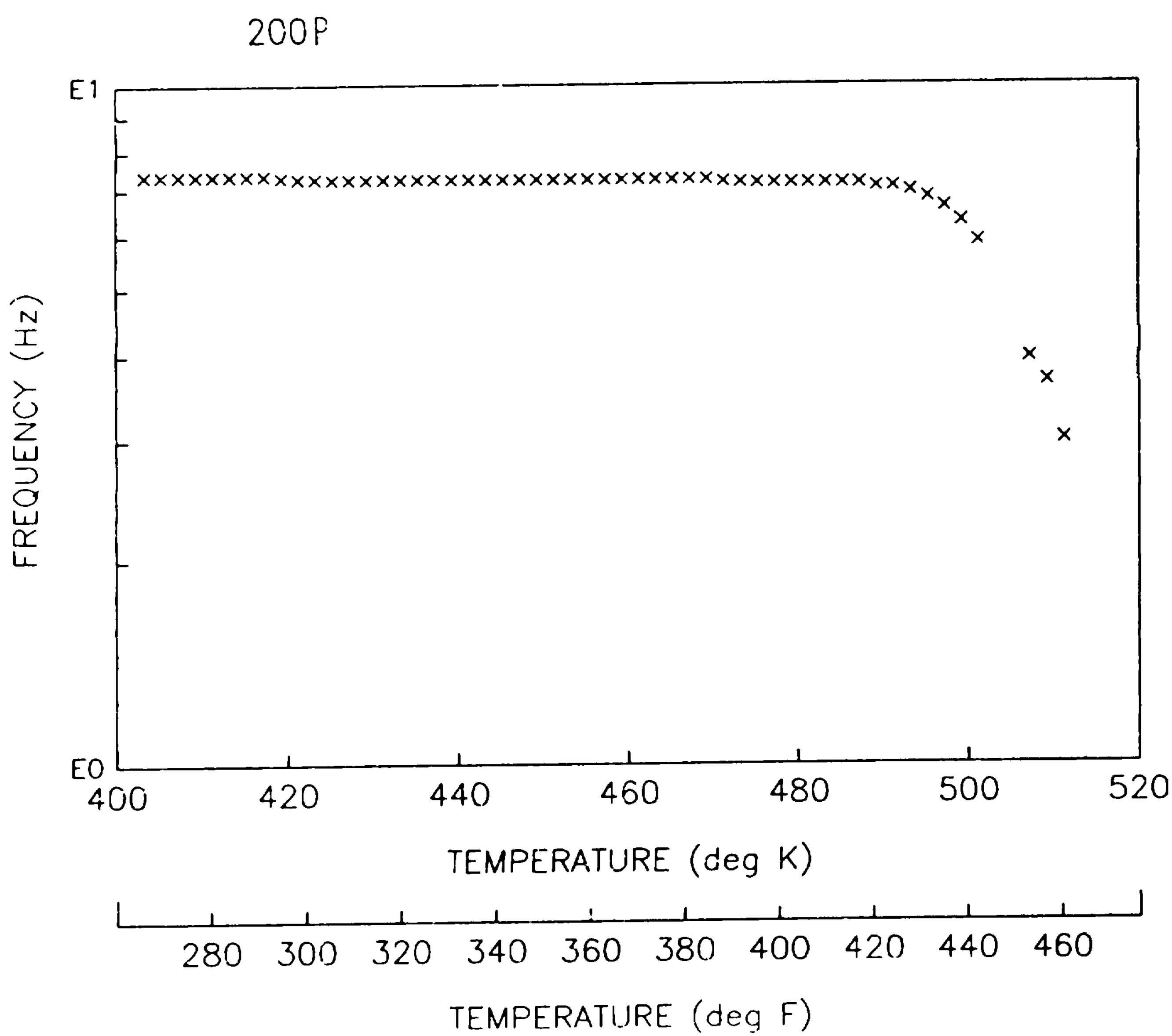


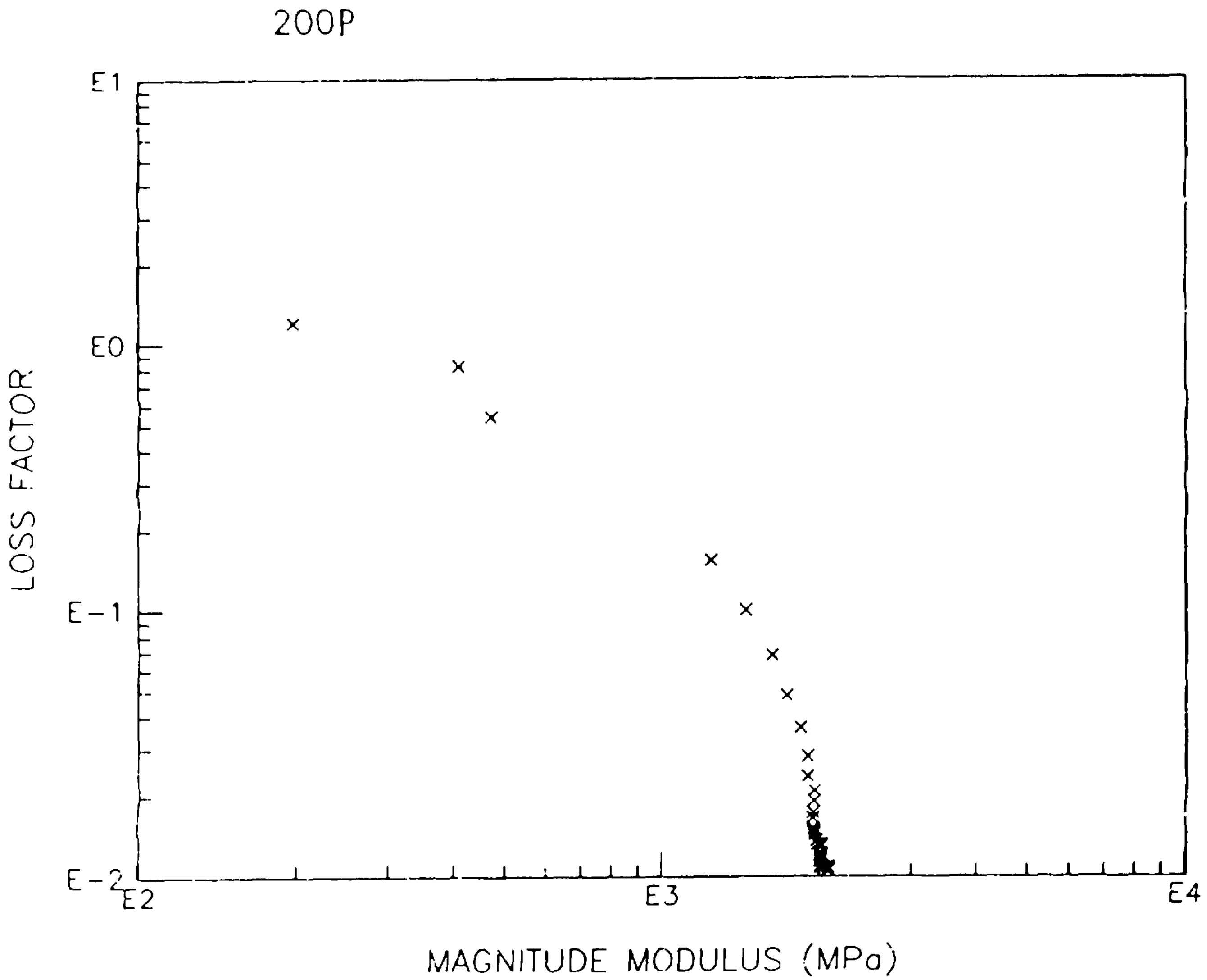
200P
YOUNG'S
Temperature (deg K)
515 500 485 470 455 440 430 420 410 400
LEGEND
× × REAL
Δ Δ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)
E4 E3 E2 E1 E0 E-1 E-2 E-3
E5 E4 E3 E2 E1 E0 E-1 E-2
E-5 E-4 E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26

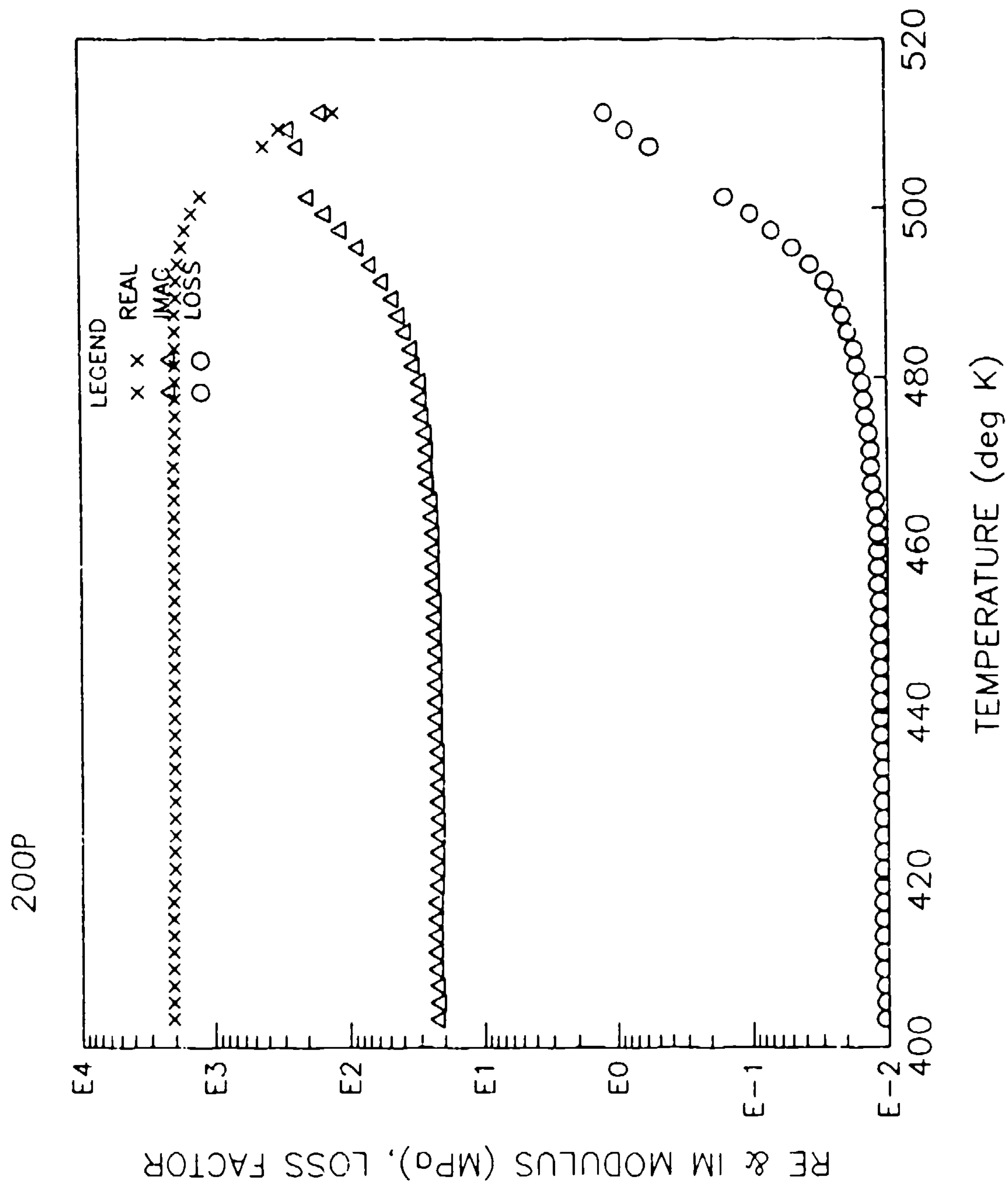
200P

YOUNG'S

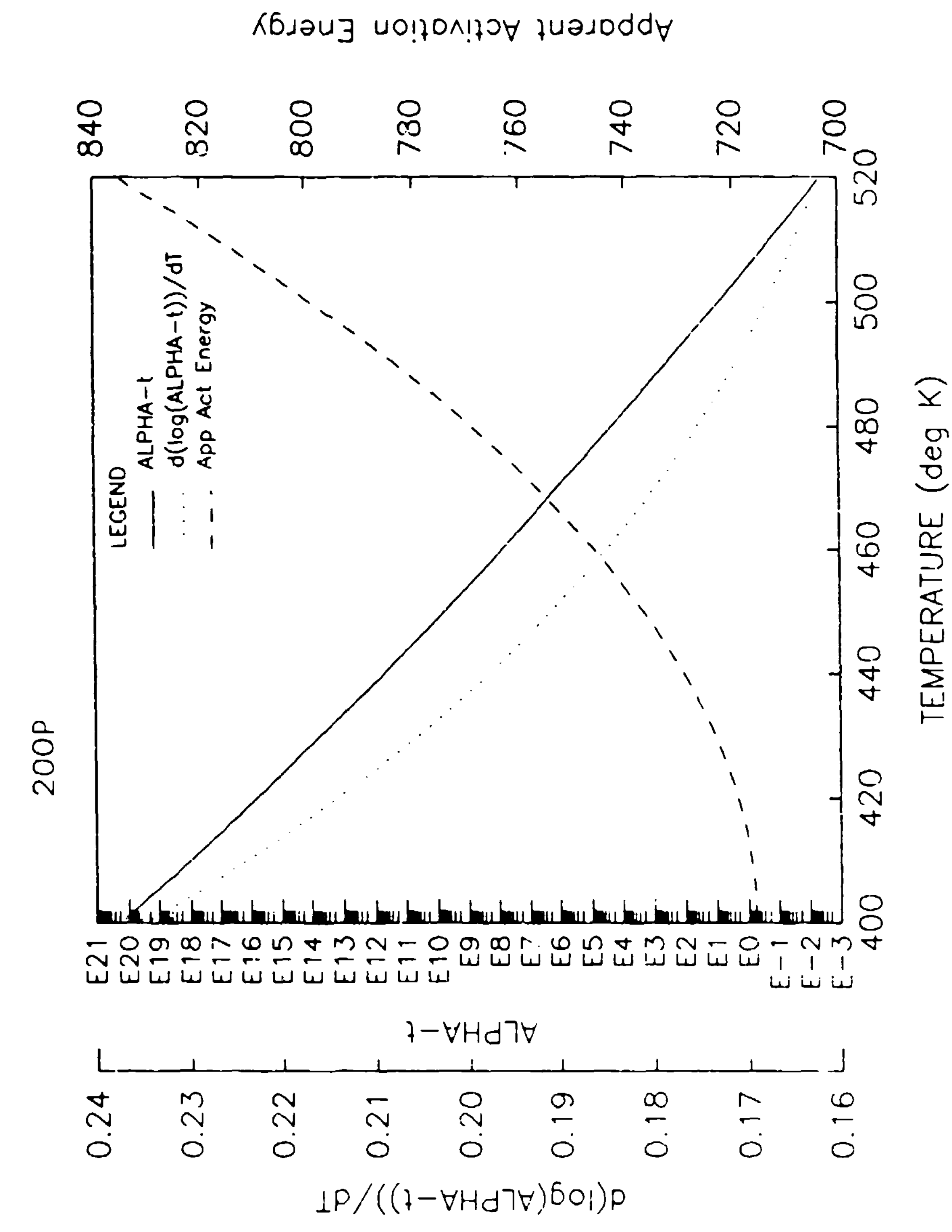

Temperature (deg F)
440 420 400 380 360 340 320 300 280 260
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E3 E2 E1 E0 E−1 E−2 E−3
FREQUENCY (Hz)
E5 E4 E3 E2 E1 E0 E−1
E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26
REDUCED FREQUENCY (Hz)


200P
E1
E0
FREQUENCY (Hz)
400
420
440
460
480
500
520
TEMPERATURE (deg K)
280
300
320
340
360
380
400
420
440
460
TEMPERATURE (deg F)


200P
E1
E0
E-1
E-2
LOSS FACTOR
E2
E3
E4
MAGNITUDE MODULUS (MPa)



200P
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
E−1
E−2
400
420
440
460
480
500
520
TEMPERATURE (deg K)


200P
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
400
420
440
460
480
500
520
ALPHA-t
E-3
E-2
E-1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
E15
E16
E17
E18
E19
E20
E21
d(log(ALPHA-t))/dT
0.16
0.17
0.18
0.19
0.20
0.21
0.22
0.23
0.24
Apparent Activation Energy
700
720
740
760
730
800
820
840

200P YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	505.0	400.0	520.0	0.1661	0.2347	0.1621

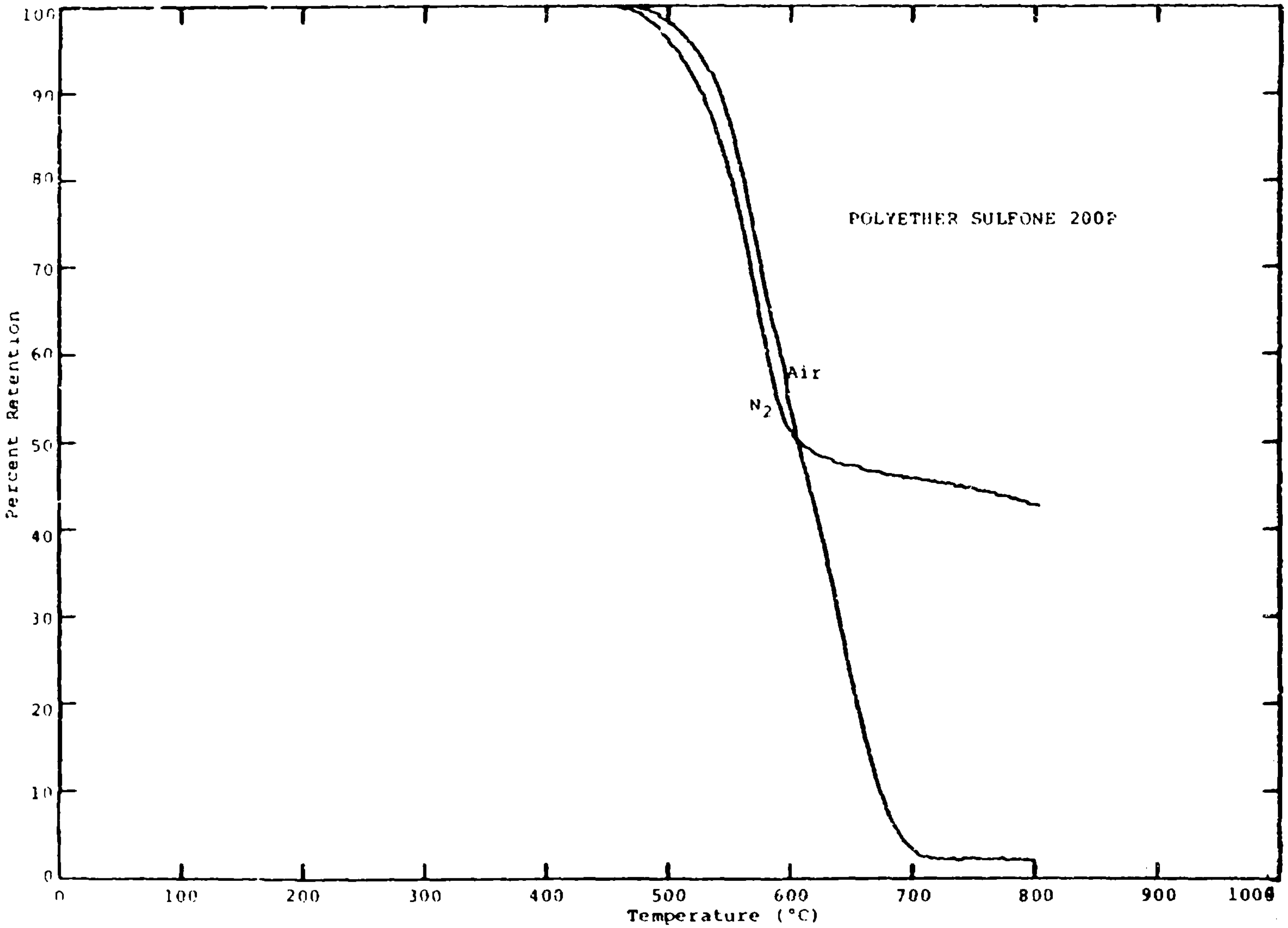
COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	53.00	3100.	12.00	0.7000	1.000	0.2000E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
403.2	7.340	2070.	0.1060E-01	21.94
405.2	7.340	2070.	0.1050E-01	21.74
407.2	7.340	2070.	0.1060E-01	21.94
409.2	7.340	2070.	0.1090E-01	22.56
411.2	7.340	2070.	0.1090E-01	22.56
413.2	7.340	2070.	0.1090E-01	22.56
415.2	7.340	2070.	0.1090E-01	22.56
417.2	7.340	2070.	0.1090E-01	22.56
419.2	7.290	2040.	0.1090E-01	22.24
421.2	7.260	2020.	0.1090E-01	22.02
423.2	7.250	2010.	0.1090E-01	21.91
425.2	7.240	2000.	0.1090E-01	21.80
427.2	7.240	2000.	0.1090E-01	21.80
429.2	7.240	2000.	0.1100E-01	22.00
431.2	7.240	2000.	0.1100E-01	22.00
433.2	7.240	2000.	0.1100E-01	22.00
435.2	7.240	2000.	0.1100E-01	22.00
437.2	7.240	2000.	0.1140E-01	22.80
439.2	7.240	2000.	0.1140E-01	22.80
441.2	7.240	2000.	0.1140E-01	22.80
443.2	7.240	2000.	0.1140E-01	22.80
445.2	7.240	2000.	0.1140E-01	22.80
447.2	7.240	2000.	0.1140E-01	22.80
449.2	7.240	2000.	0.1150E-01	23.00
451.2	7.240	2000.	0.1150E-01	23.00
453.2	7.240	2000.	0.1150E-01	23.00
455.2	7.240	2000.	0.1180E-01	23.60
457.2	7.240	2000.	0.1180E-01	23.60
459.2	7.240	2000.	0.1180E-01	23.60
461.2	7.240	2000.	0.1180E-01	23.60
463.2	7.240	2000.	0.1210E-01	24.20
465.2	7.240	2000.	0.1220E-01	24.40
467.2	7.240	2000.	0.1290E-01	25.80
469.2	7.240	2000.	0.1320E-01	26.40
471.2	7.190	1970.	0.1320E-01	26.00
473.2	7.160	1960.	0.1360E-01	26.66
475.2	7.150	1950.	0.1430E-01	27.89
477.2	7.150	1950.	0.1470E-01	28.67
479.2	7.140	1940.	0.1500E-01	29.10
481.2	7.140	1940.	0.1650E-01	32.01

Temp (DEG K)	Freq (HZ)	MReal	Eta (MPA)	MImag (MPA)
483.2	7.140	1940.	0.1720E-01	33.37
485.2	7.140	1940.	0.1910E-01	37.05
487.2	7.140	1940.	0.2100E-01	40.74
489.2	7.050	1890.	0.2380E-01	44.98
491.2	7.050	1890.	0.2820E-01	53.30
493.2	6.950	1830.	0.3600E-01	65.88
495.2	6.780	1720.	0.4790E-01	82.39
497.2	6.570	1610.	0.6830E-01	110.0
499.2	6.260	1430.	0.9980E-01	142.7
501.2	5.860	1220.	0.1530	186.7
507.2	3.950	410.0	0.5440	223.0
509.2	3.650	313.0	0.8280	259.2
511.2	3.000	125.0	1.210	151.3

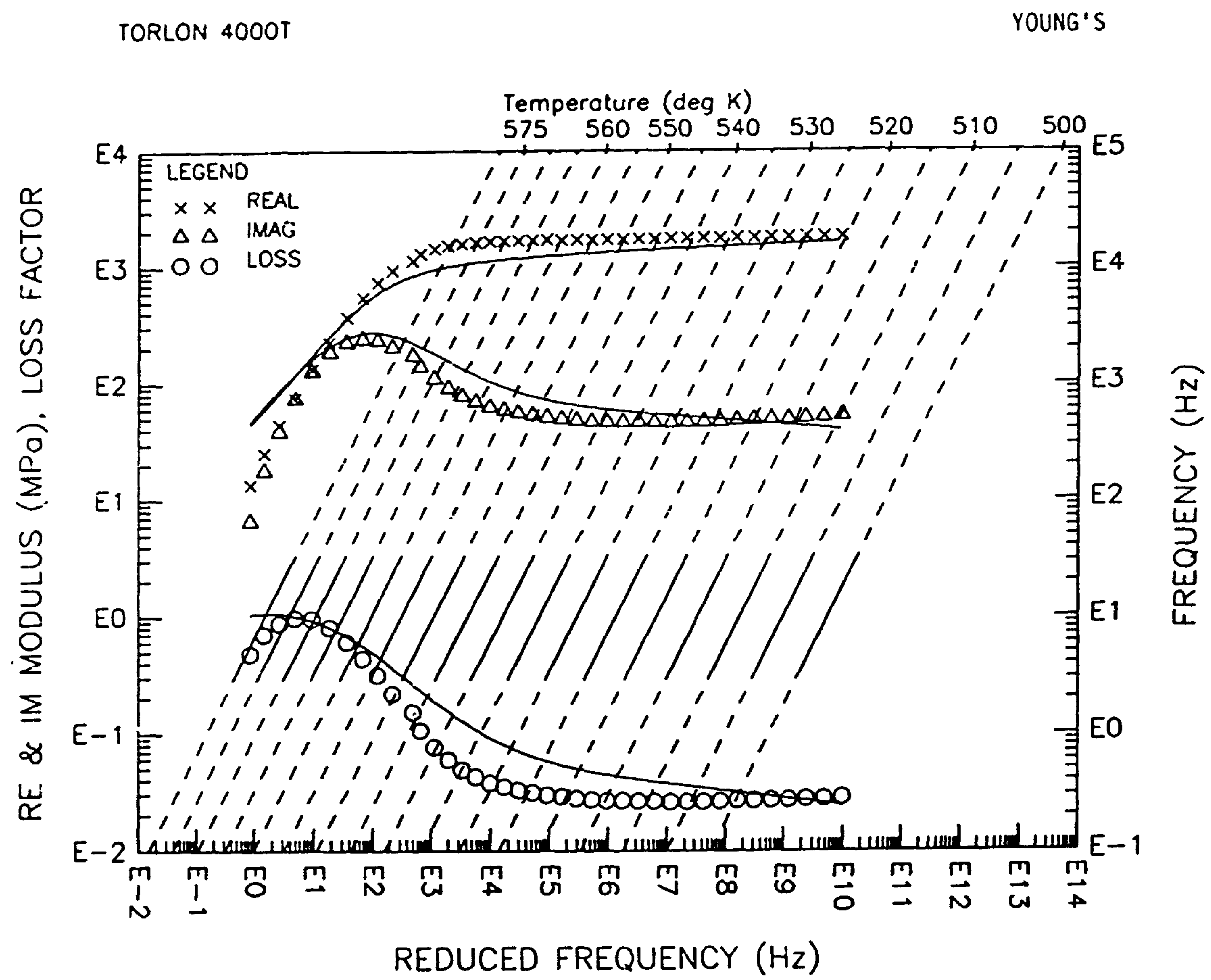


TGA Weight Loss Thermograms for Victrex 200P Polyethersulfone.

TORLON 4000T

YOUNG'S

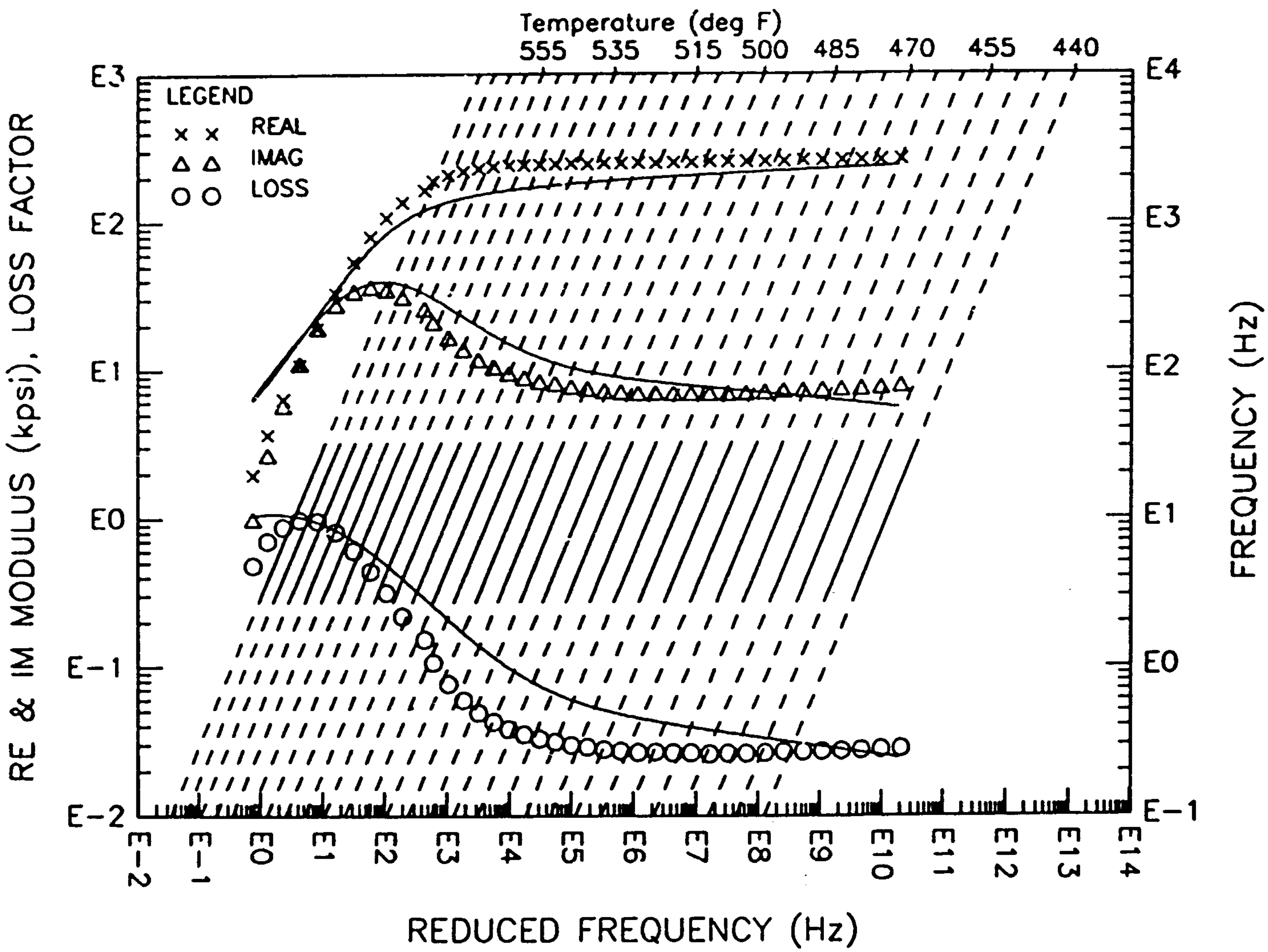
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.2442E-01	0.7495	1.071	0.7495	1.044
MODULUS	MPA	1620.	333.9	67.13	60.72	45.11
	PSI	0.2350E+06	0.4842E+05	9736.	8806.	6543.
	DEG K		565.0	579.0	580.0	
10.HZ	DEG C		271.9	285.9	286.9	
	DEG F		521.3	546.5	548.3	
	DEG K		577.0	580.0	0.0000E+00	
100.HZ	DEG C		283.9	286.9	-293.1	
	DEG F		542.9	548.3	-495.7	
	DEG K		580.0	580.0	0.0000E+00	
1000.HZ	DEG C		286.9	286.9	-293.1	
	DEG F		548.3	548.3	-495.7	

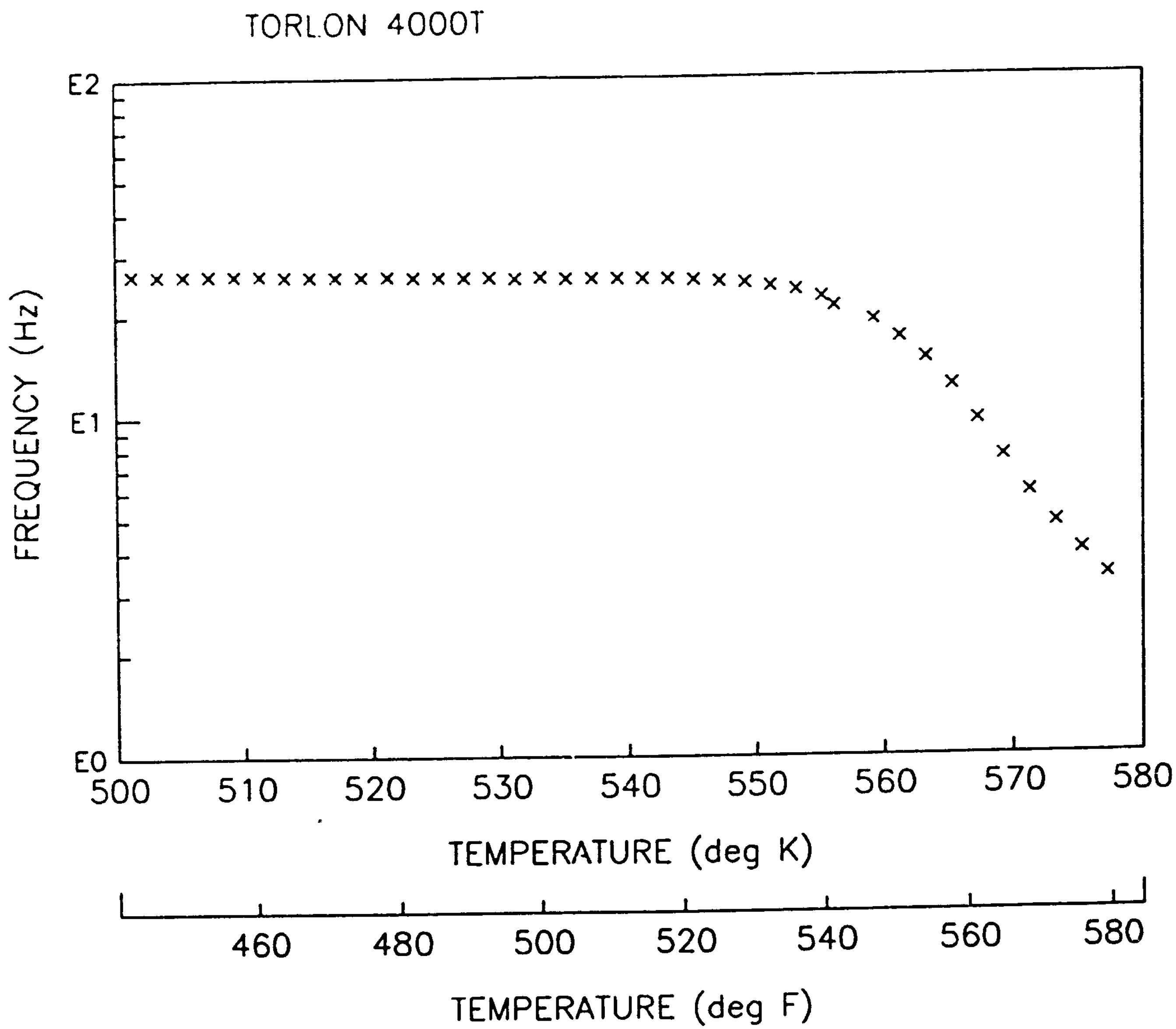


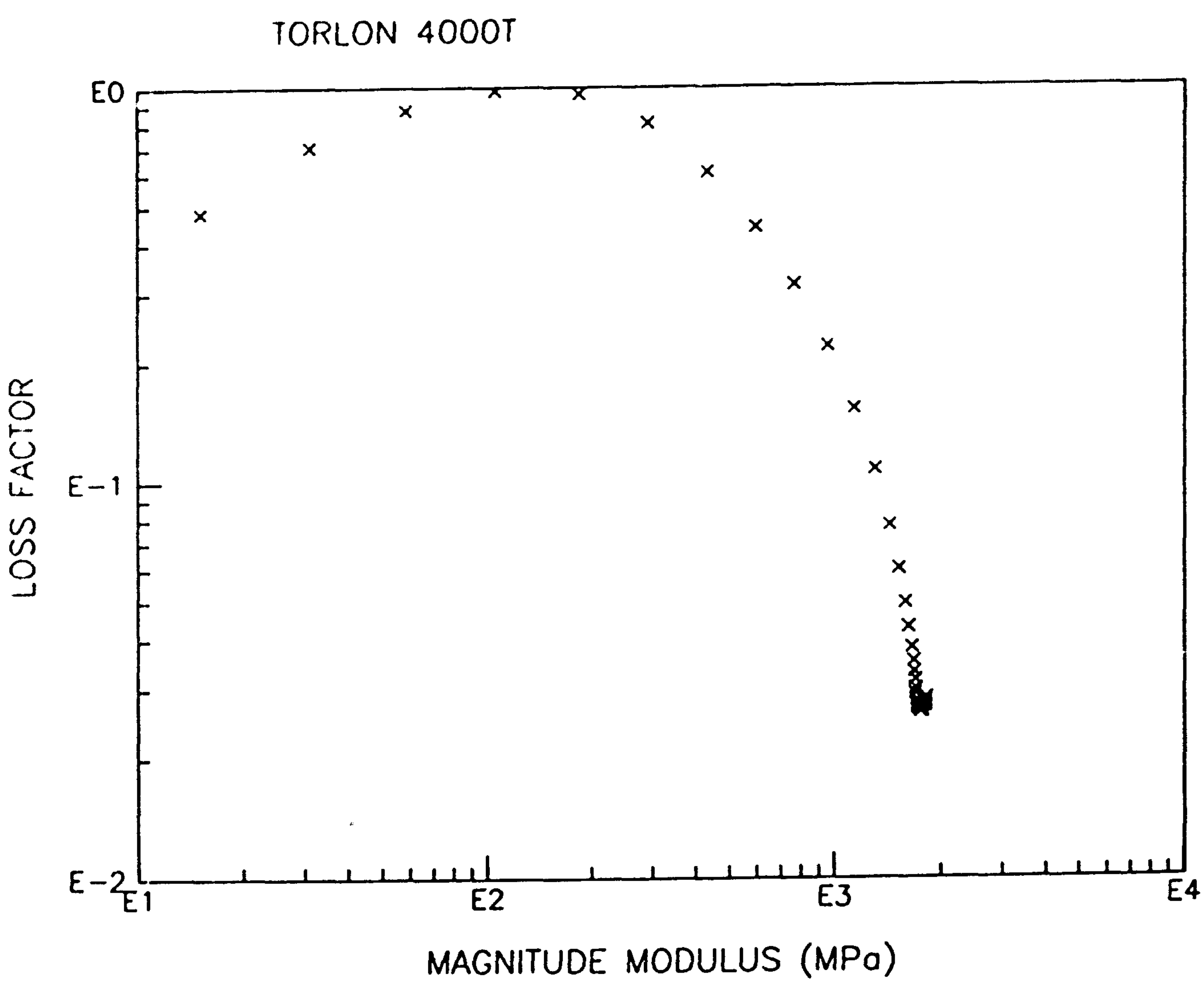
TORLON 4000T
YOUNG'S
Temperature (deg K)
575
560
550
540
530
520
510
500
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
E4
E3
E2
E1
E0
E−1
E−2
E5
E4
E3
E2
E1
E0
E−1
E−2
E−1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)

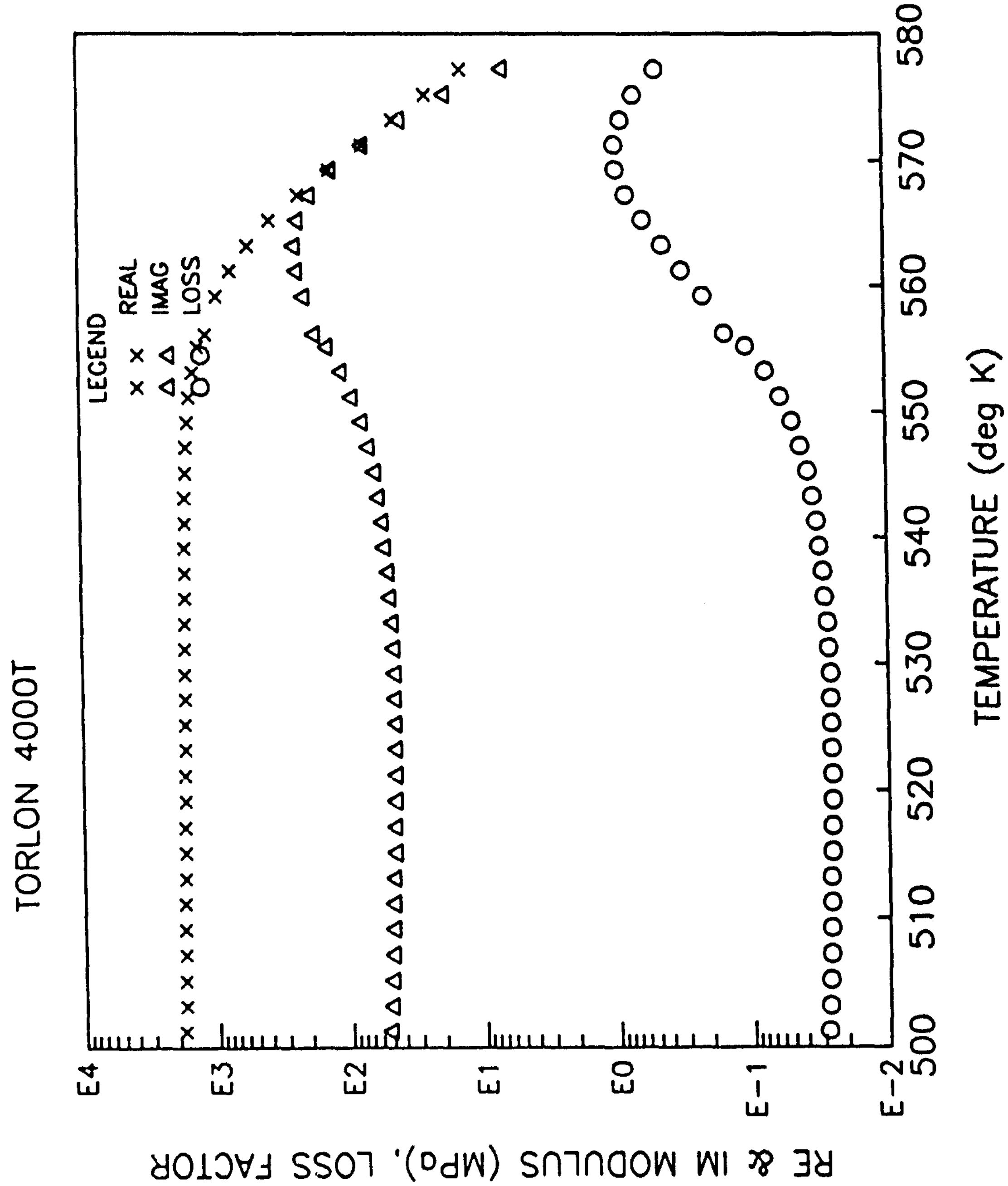
TORLON 4000T

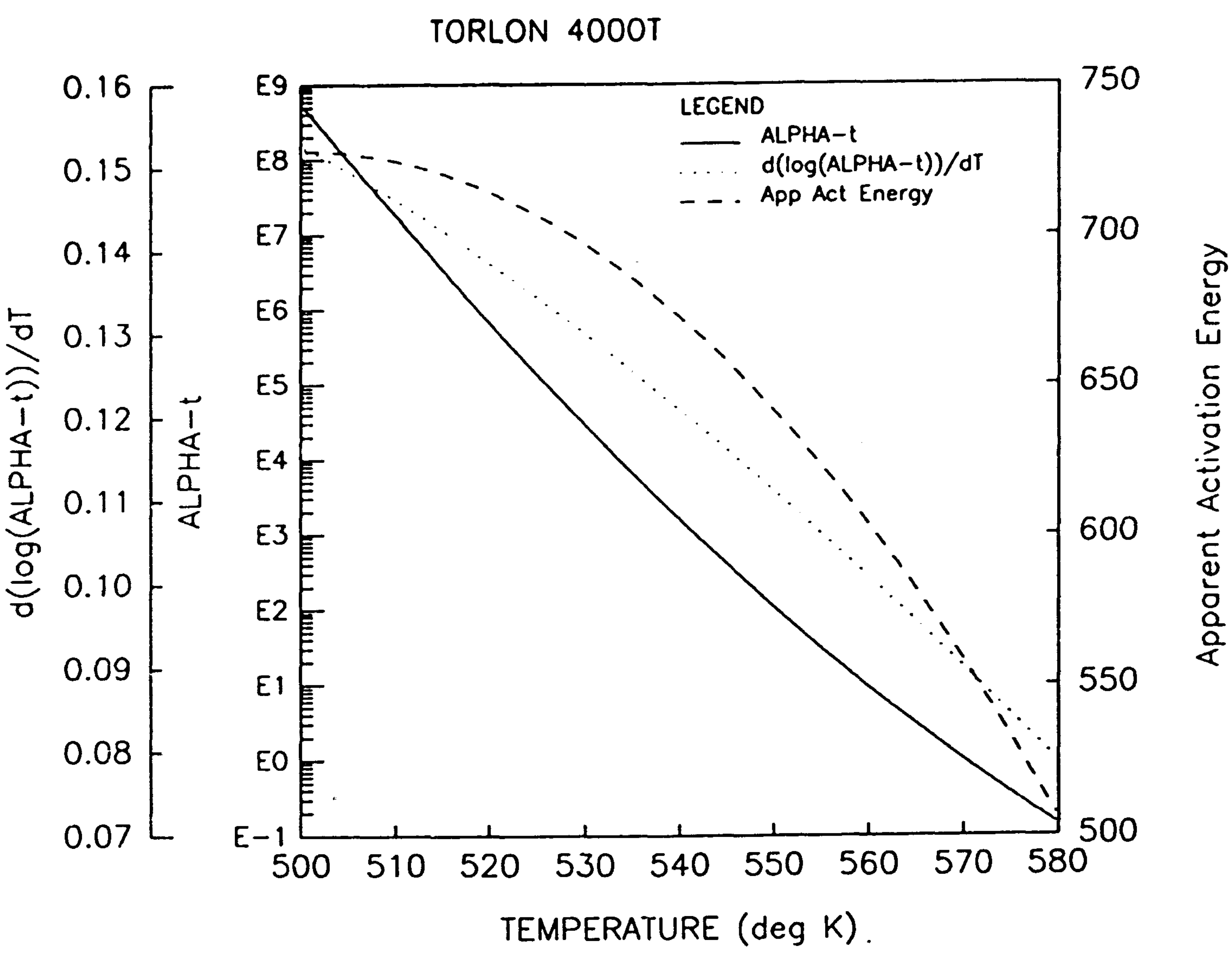
YOUNG'S




TORLON 4000T
FREQUENCY (Hz)
E2
E1
E0
500
510
520
530
540
550
560
570
580
TEMPERATURE (deg K)
460
480
500
520
540
560
580
TEMPERATURE (deg F)


TORLON 4000T
LOSS FACTOR
E0
E-1
E-2
E1
E2
E3
E4
MAGNITUDE MODULUS (MPa)


TORLON 4000T
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
E4
E3
E2
E1
E0
E−1
E−2
RE & IM MODULUS (MPa), LOSS FACTOR
500
510
520
530
540
550
560
570
580
TEMPERATURE (deg K)


TORLON 4000T
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
ALPHA-t
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
500
510
520
530
540
550
560
570
580
750
700
650
600
550
500
Apparent Activation Energy
TEMPERATURE (deg K)

TORLON 4000T YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	570.0	500.0	580.0	0.9000E-01	0.1527	0.7880E-01

COMPLEX MODULUS MODEL

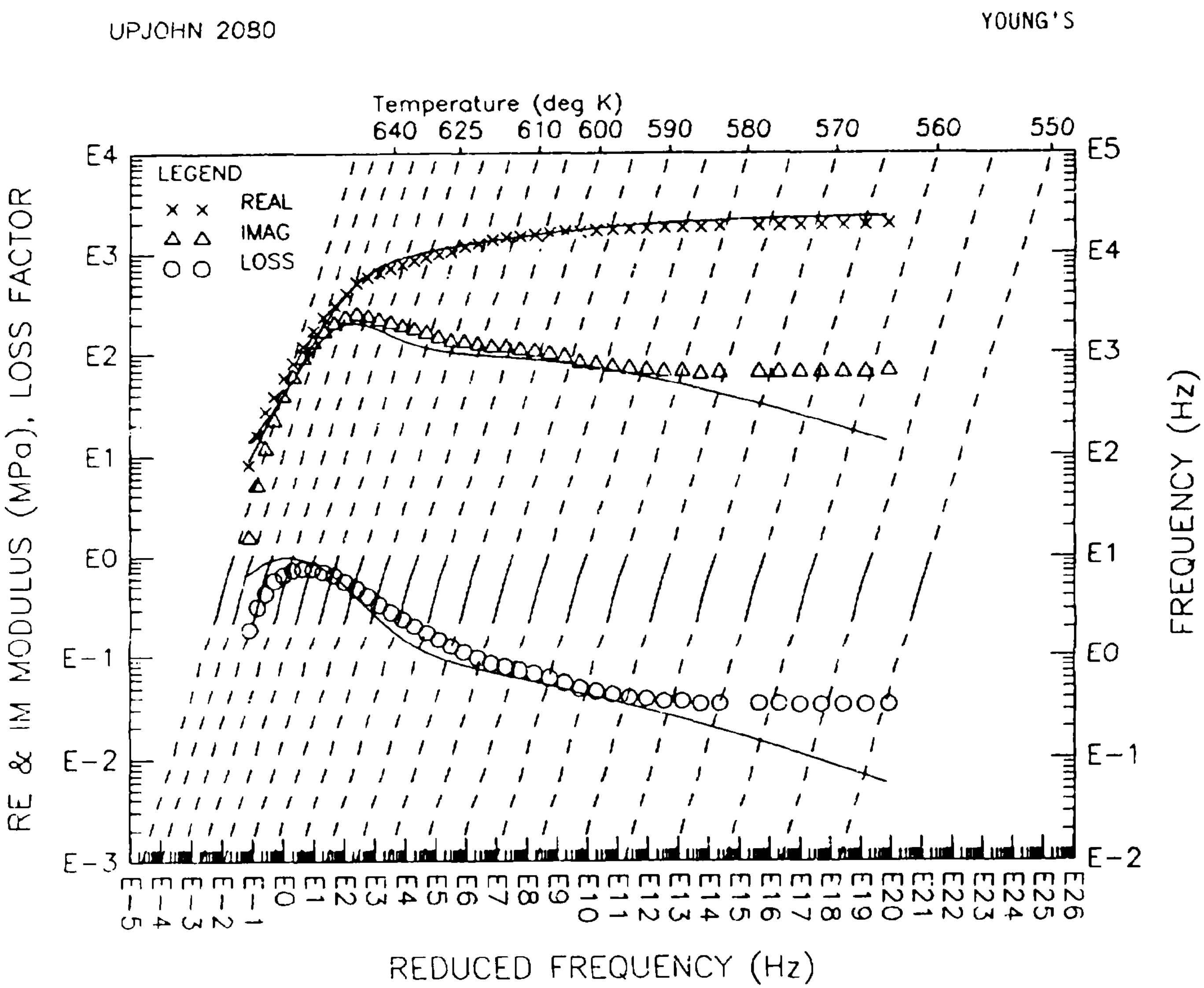
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	10.00	2000.	200.0	0.6300	1.000	0.8000E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
501.2	26.50	1820.	0.2840E-01	51.69
503.2	26.40	1800.	0.2800E-01	50.40
505.2	26.40	1800.	0.2770E-01	49.86
507.2	26.40	1800.	0.2730E-01	49.14
509.2	26.30	1790.	0.2710E-01	48.51
511.2	26.30	1790.	0.2700E-01	48.33
513.2	26.10	1770.	0.2700E-01	47.79
515.2	26.00	1760.	0.2650E-01	46.64
517.2	26.00	1760.	0.2630E-01	46.29
519.2	26.00	1750.	0.2630E-01	46.03
521.2	26.00	1750.	0.2610E-01	45.67
523.2	25.90	1730.	0.2650E-01	45.85
525.2	25.90	1730.	0.2650E-01	45.85
527.2	25.80	1720.	0.2690E-01	46.27
529.2	25.80	1720.	0.2670E-01	45.92
531.2	25.60	1710.	0.2730E-01	46.68
533.2	25.70	1710.	0.2790E-01	47.71
535.2	25.50	1690.	0.2910E-01	49.18
537.2	25.60	1700.	0.2990E-01	50.83
539.2	25.50	1690.	0.3150E-01	53.24
541.2	25.50	1680.	0.3300E-01	55.44
543.2	25.40	1670.	0.3520E-01	58.78
545.2	25.20	1650.	0.3810E-01	62.87
547.2	25.00	1620.	0.4280E-01	69.34
549.2	24.70	1580.	0.4930E-01	77.89
551.2	24.20	1520.	0.5990E-01	91.05
553.2	23.50	1430.	0.7710E-01	110.3
555.2	22.40	1300.	0.1070	139.1
556.2	21.00	1130.	0.1530	172.9
559.2	19.10	937.0	0.2200	206.1
561.2	16.90	734.0	0.3160	231.9
563.2	14.70	547.0	0.4410	241.2
565.2	12.20	372.0	0.6090	226.5
567.2	9.640	227.0	0.8140	184.8
569.2	7.540	133.0	0.9630	128.1
571.2	5.900	75.10	0.9830	73.82
573.2	4.790	44.00	0.8770	38.59
575.2	3.970	25.30	0.7060	17.86
577.2	3.360	13.60	0.4830	6.569

UPJOHN 2080 YOUNG'S

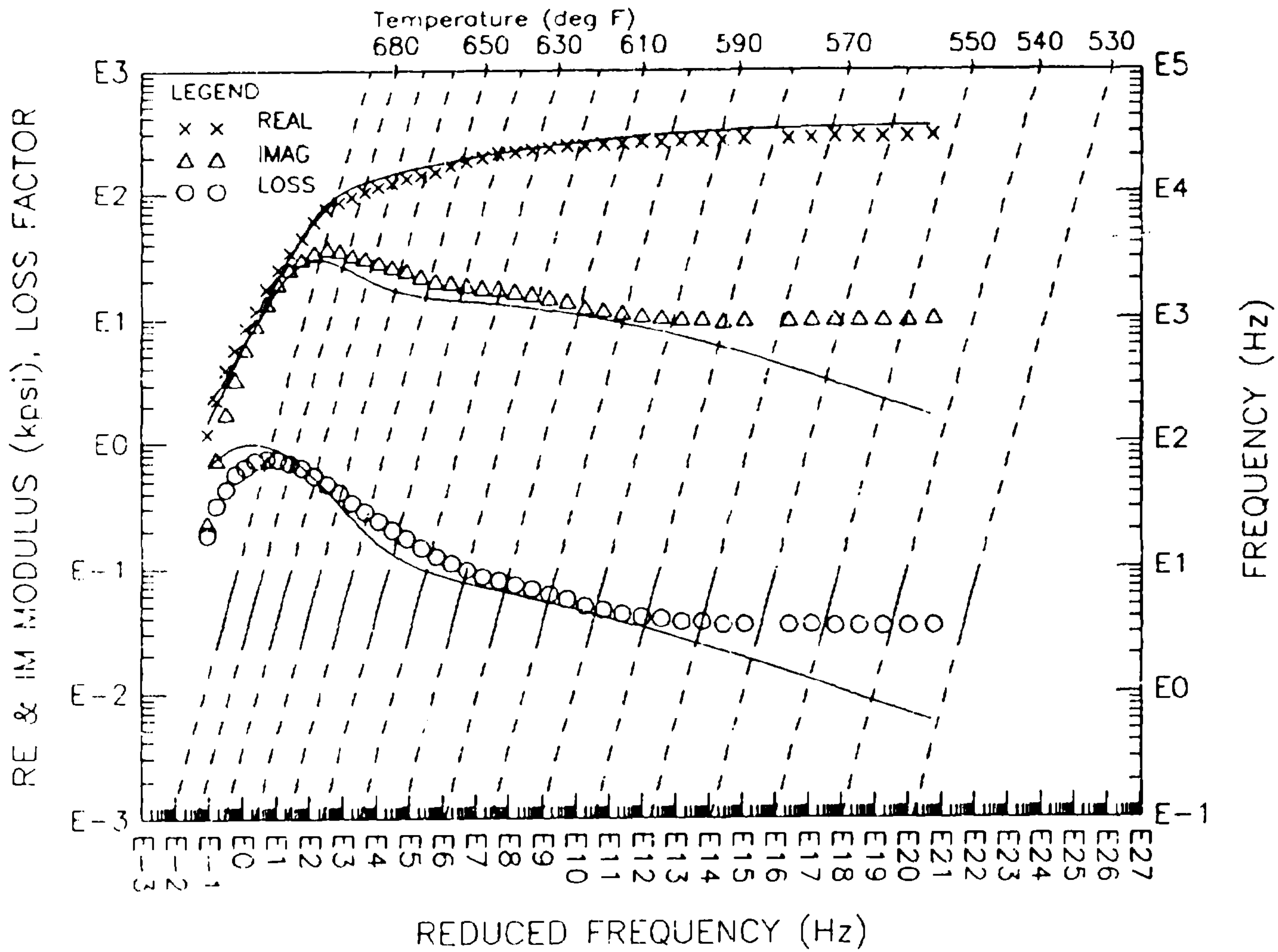
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.5760E-02	0.6846	0.9780	0.6846	0.6484
MODULUS	MPA	2319.	274.9	48.17	14.90	13.75
	PSI	0.3364E+06	0.3988E+05	6986.	2161.	1995.
	DEG K		626.0	636.0	645.0	
10.HZ	DEG C		332.9	342.9	351.9	
	DEG F		631.1	649.1	665.3	
	DEG K		633.0	643.0	650.0	
100.HZ	DEG C		339.9	349.9	356.9	
	DEG F		643.7	661.7	674.3	
	DEG K		640.0	650.0	0.0000E+00	
1000.HZ	DEG C		346.9	356.9	-293.1	
	DEG F		656.3	674.3	-495.7	

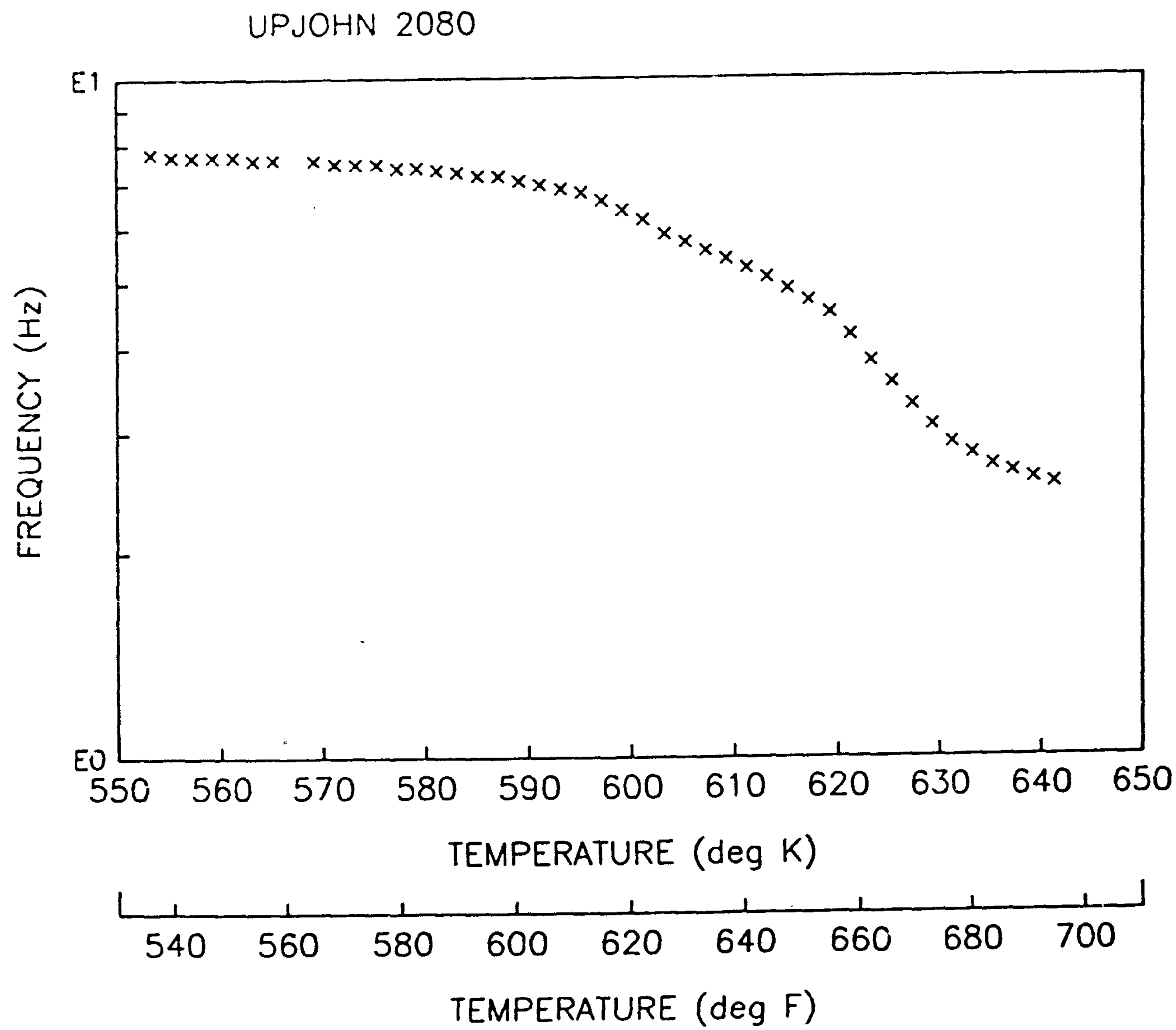


UPJOHN 2080
YOUNG'S
Temperature (deg K)
640 625 610 600 590 580 570 560 550
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)

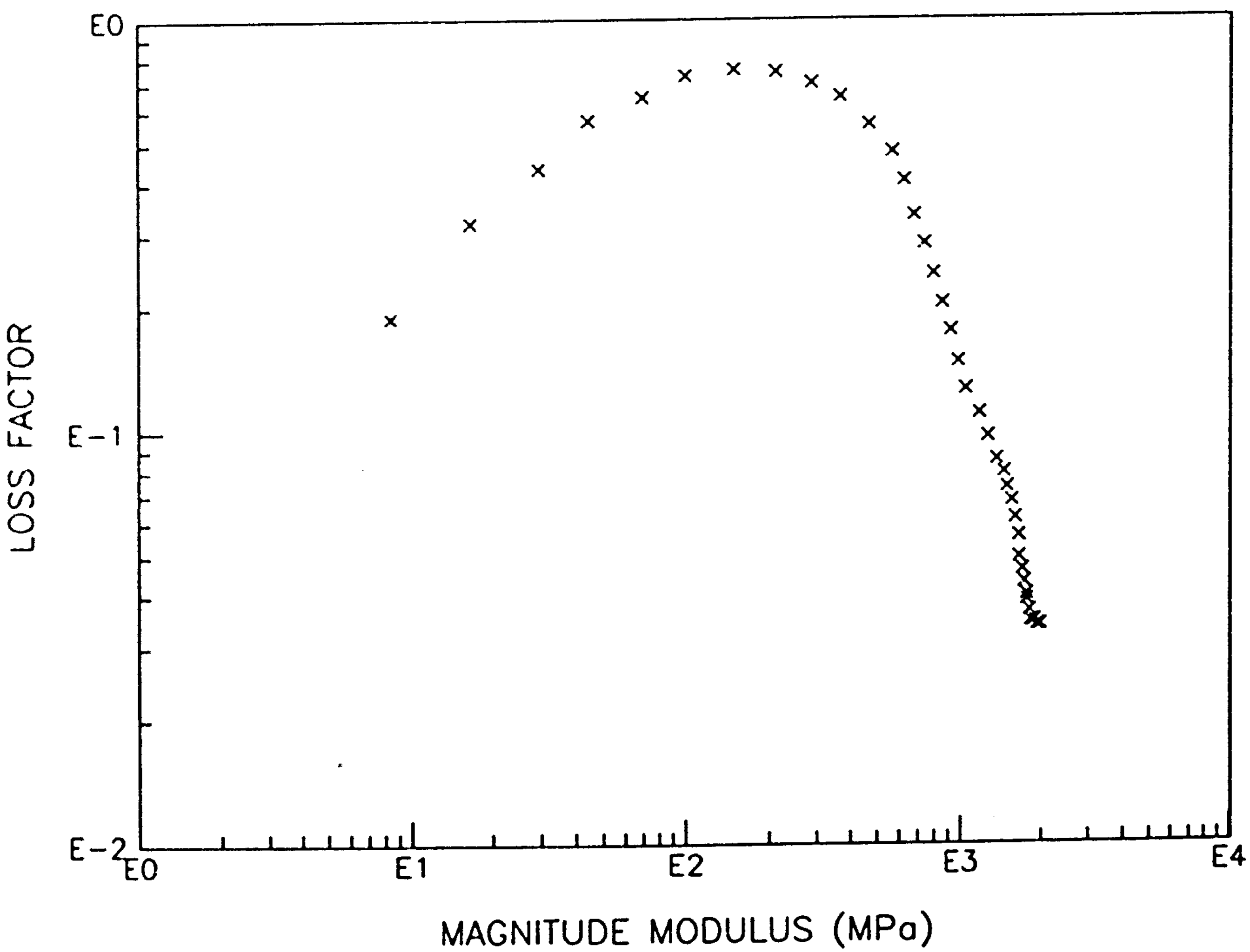
UPJOHN 2080

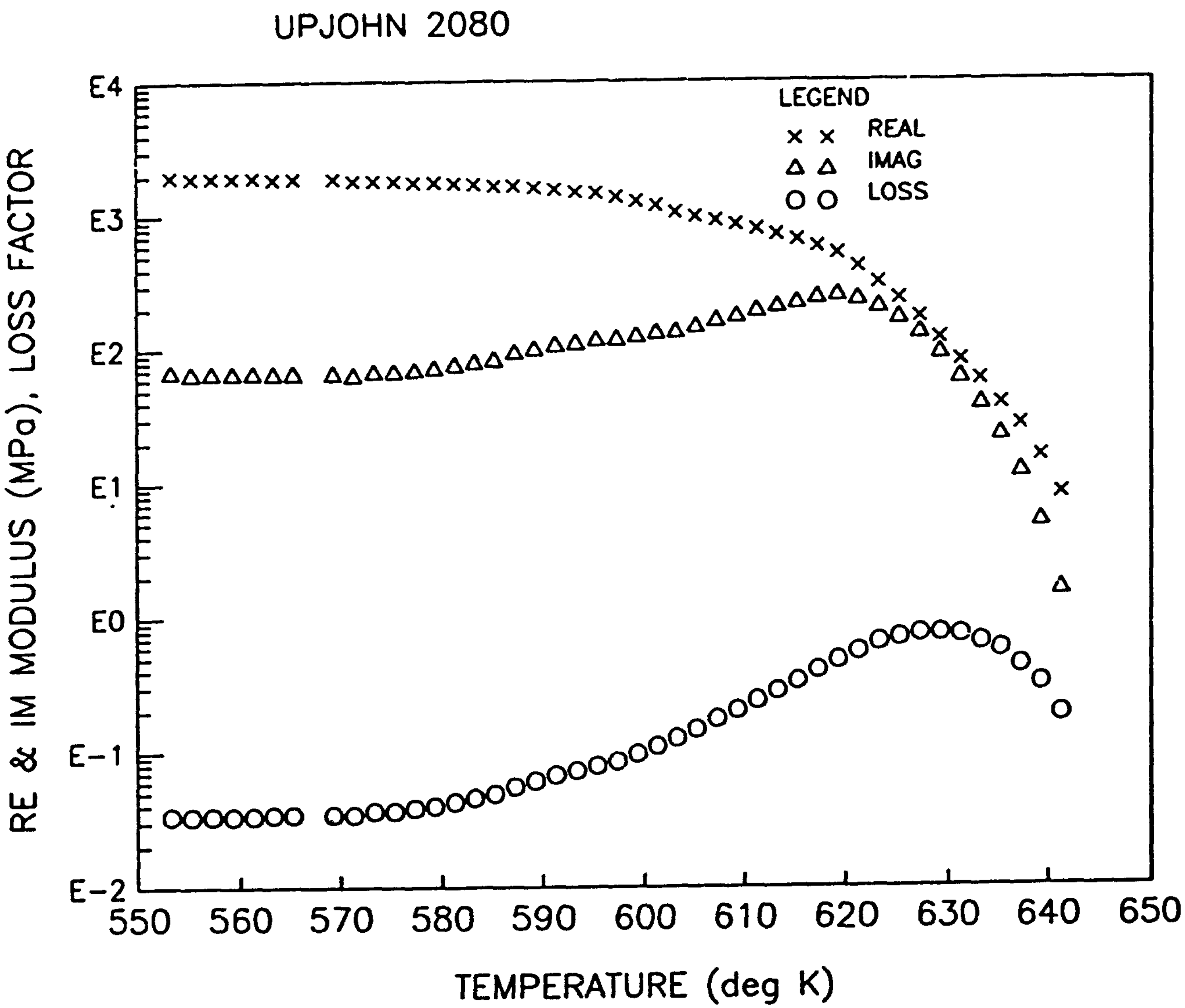
YOUNG'S




UPJOHN 2080
E1
E0
FREQUENCY (Hz)
550
560
570
580
590
600
610
620
630
640
650
TEMPERATURE (deg K)
540
560
580
600
620
640
660
680
700
TEMPERATURE (deg F)

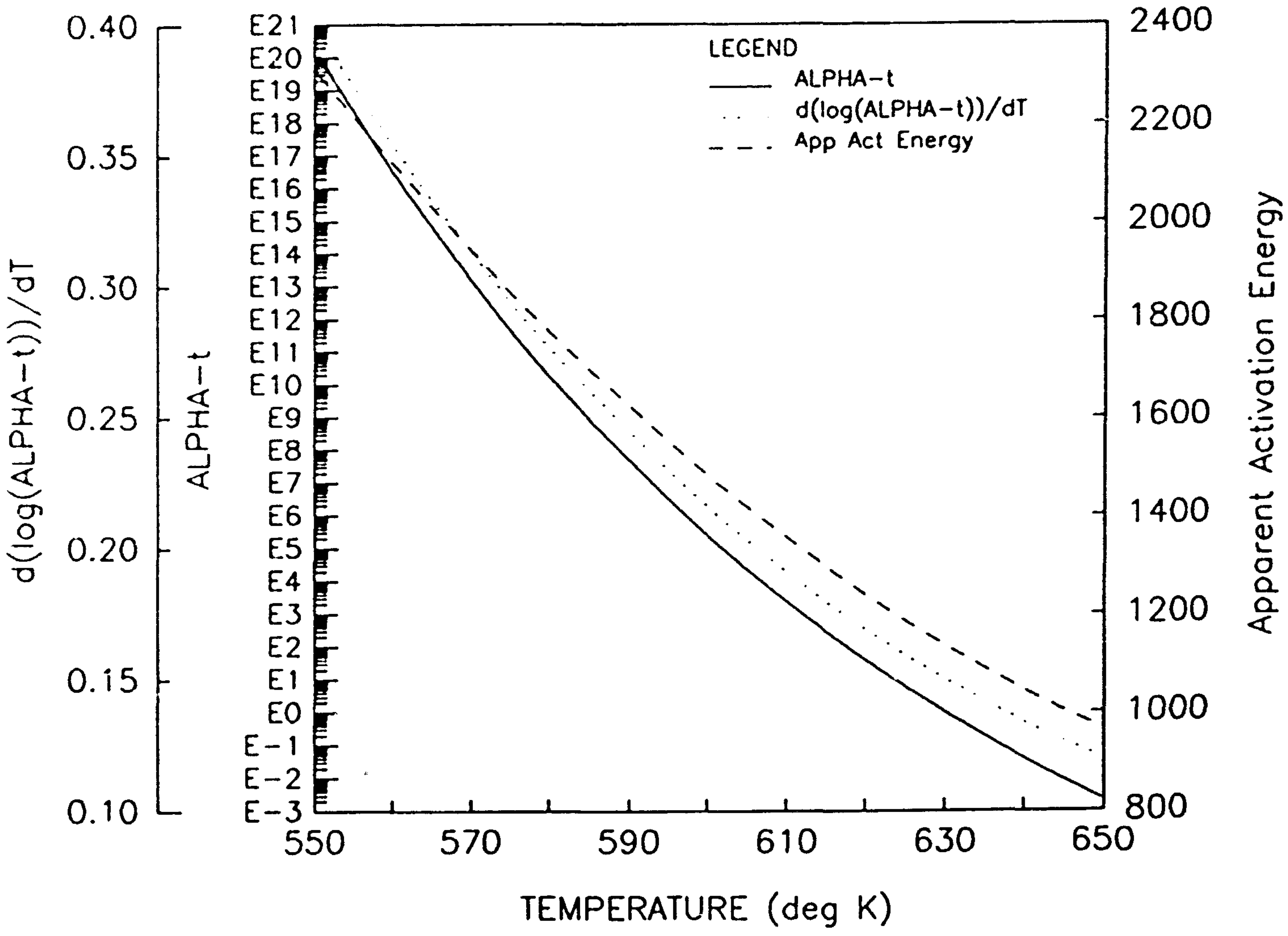
UPJOHN 2080





UPJOHN 2080
LEGEND
REAL
IMAG
LOSS
E4
E3
E2
E1
E0
E−1
E−2
550
560
570
580
590
600
610
620
630
640
650
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR

UPJOHN 2080



0.40
0.35
0.30
0.25
0.20
0.15
0.10
d(log(ALPHA-t))/dT
ALPHA-t
E21
E20
E19
E18
E17
E16
E15
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
2400
2200
2000
1800
1600
1400
1200
1000
800
Apparent Activation Energy
550
570
590
610
630
650
TEMPERATURE (deg K)

UPJOHN 2080 YOUNG'S

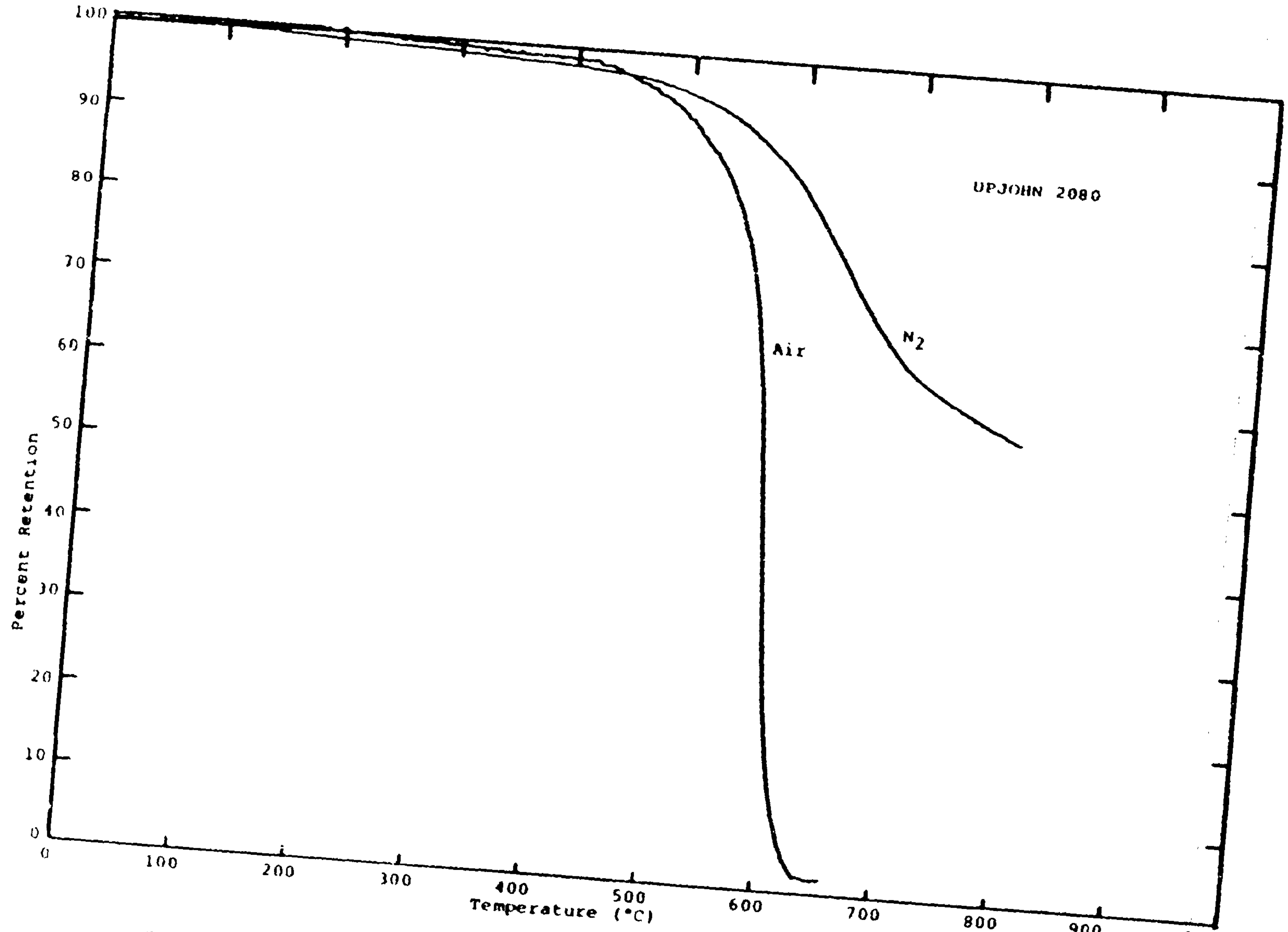
ALFA-T MODEL							
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	630.0	550.0	650.0	0.1500	0.4000	0.1200

COMPLEX MODULUS MODEL							
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	7.000	2400.	515.0	0.6000	2.000	0.1000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
553.2	7.780	1980.	0.3380E-01	66.92
555.2	7.690	1930.	0.3360E-01	64.85
557.2	7.680	1930.	0.3370E-01	65.04
559.2	7.680	1930.	0.3370E-01	65.04
561.2	7.680	1930.	0.3370E-01	65.04
563.2	7.590	1880.	0.3450E-01	64.86
565.2	7.590	1880.	0.3450E-01	64.86
569.2	7.570	1870.	0.3460E-01	64.70
571.2	7.490	1820.	0.3450E-01	62.79
573.2	7.470	1810.	0.3660E-01	66.25
575.2	7.470	1810.	0.3660E-01	66.25
577.2	7.380	1760.	0.3870E-01	68.11
579.2	7.380	1760.	0.3990E-01	70.22
581.2	7.320	1730.	0.4280E-01	74.04
583.2	7.260	1700.	0.4580E-01	77.86
585.2	7.180	1650.	0.4910E-01	81.01
587.2	7.180	1650.	0.5540E-01	91.41
589.2	7.060	1600.	0.6110E-01	97.76
591.2	6.970	1550.	0.6730E-01	104.3
593.2	6.860	1490.	0.7270E-01	108.3
595.2	6.780	1450.	0.7890E-01	114.4
597.2	6.590	1360.	0.8510E-01	115.7
599.2	6.380	1260.	0.9640E-01	121.5
601.2	6.180	1170.	0.1100	128.7
603.2	5.880	1040.	0.1260	131.0
605.2	5.730	974.0	0.1470	143.2
607.2	5.570	908.0	0.1750	158.9
609.2	5.410	844.0	0.2040	172.2
611.2	5.240	778.0	0.2400	186.7
613.2	5.070	714.0	0.2840	202.8
615.2	4.880	645.0	0.3340	215.4
617.2	4.700	582.0	0.4050	235.7
619.2	4.500	515.0	0.4760	245.1
621.2	4.170	411.0	0.5550	228.1
623.2	3.820	309.0	0.6490	200.5
625.2	3.550	236.0	0.7010	165.4
627.2	3.290	171.0	0.7470	127.7
629.2	3.070	120.0	0.7550	90.60
631.2	2.890	81.20	0.7300	59.28
633.2	2.780	58.50	0.6480	37.91

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
635.2	2.680	38.50	0.5700	21.94
637.2	2.620	26.90	0.4340	11.67
639.2	2.560	15.60	0.3200	4.992
641.2	2.520	8.200	0.1890	1.550

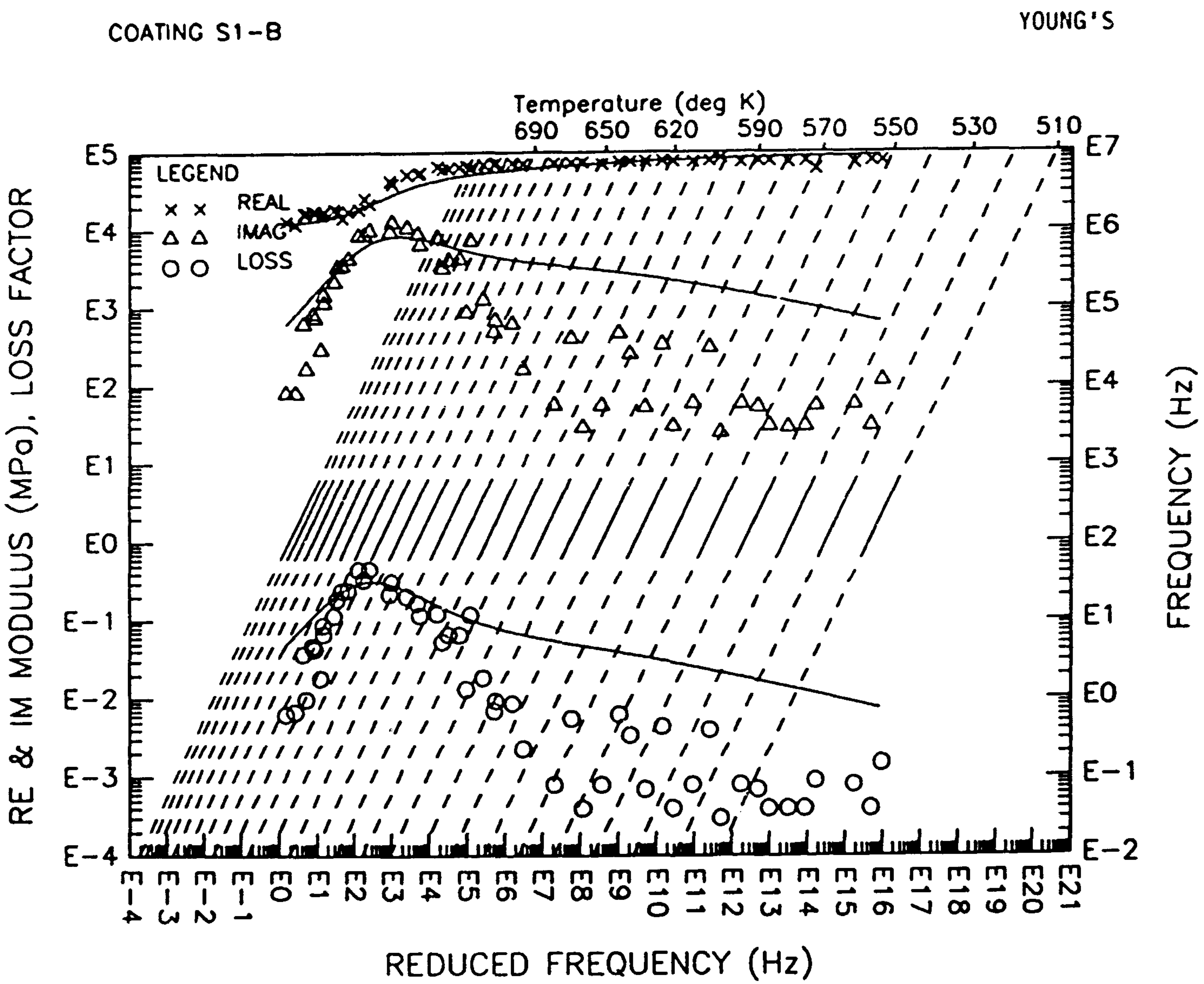


TGA Weight Loss Thermograms for Upjohn 2080 Methylenedianiline Polyimide.

COATING SI-3

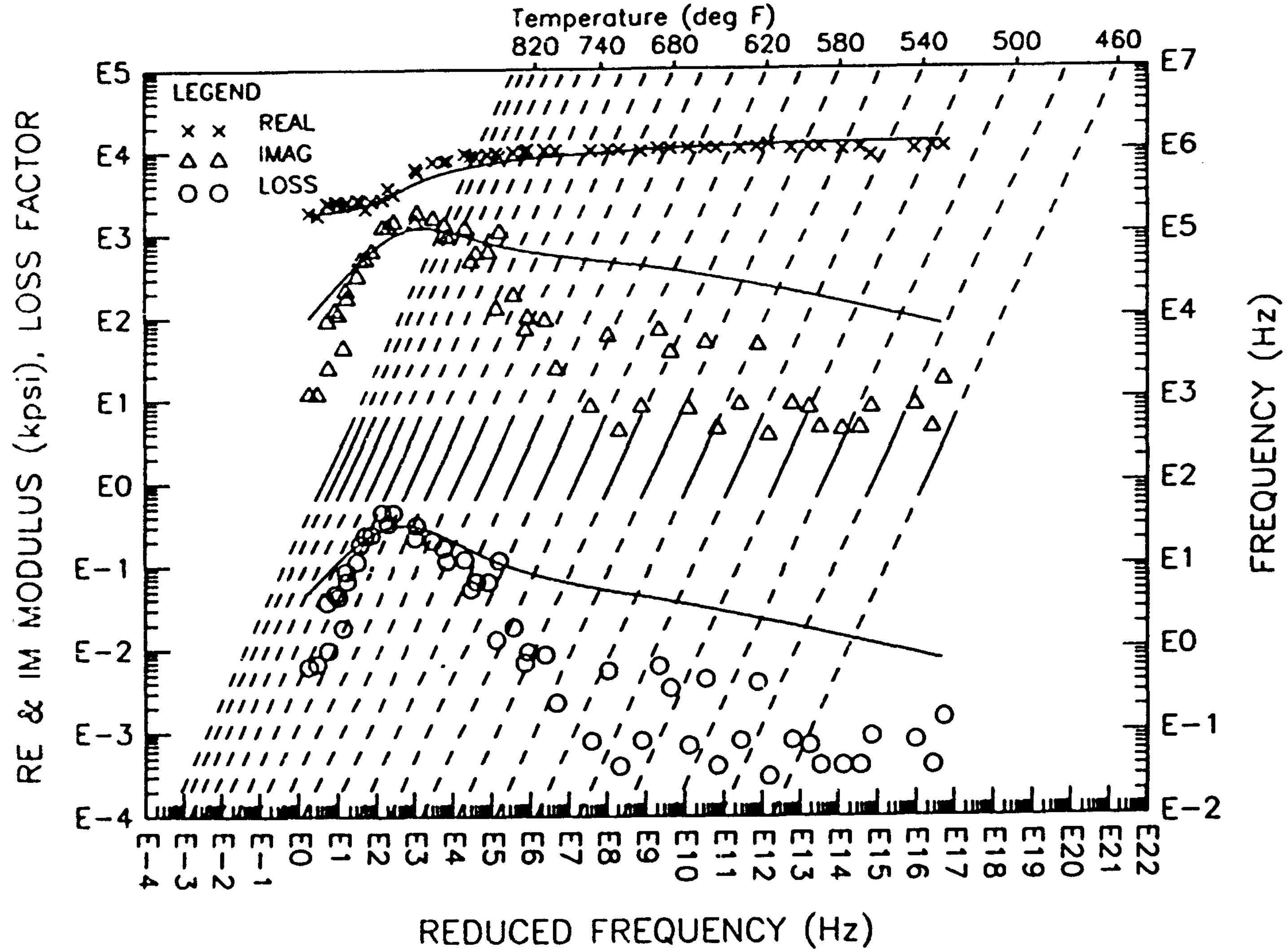
YOUNG'S

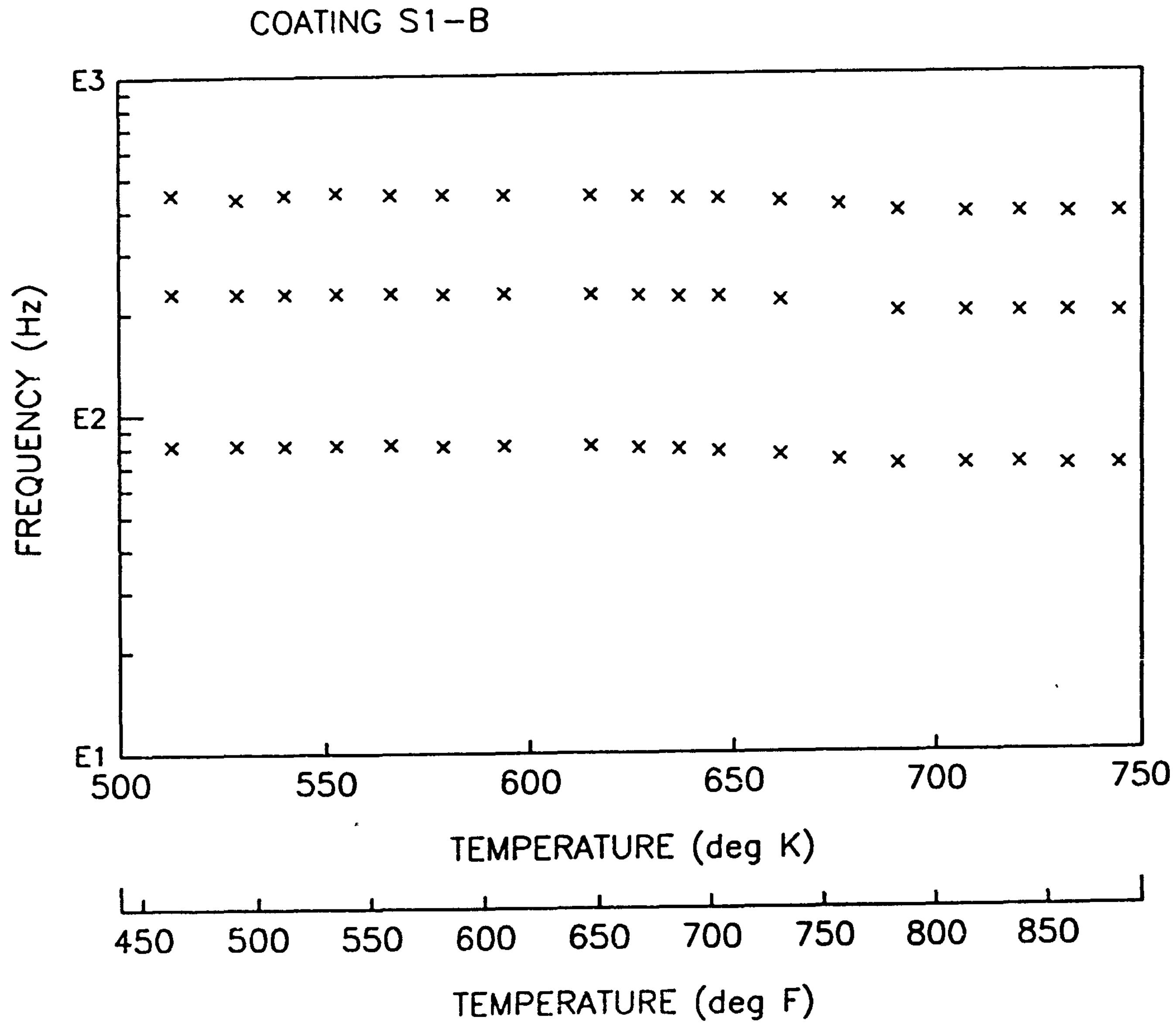
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.7358E-02	0.2193	0.3133	0.2193	0.4931E-01
MODULUS	MPA	0.8842E+05	0.3728E+05	0.2253E+05	0.1534E+05	0.1248E+05
	PSI	0.1282E+08	0.5406E+07	0.3267E+07	0.2224E+07	0.1810E+07
10.HZ	DEG K		633.0	653.0	672.0	
	DEG C		339.9	359.9	378.9	
	DEG F		643.7	679.7	713.9	
100.HZ	DEG K		650.0	673.0	696.0	
	DEG C		356.9	379.9	402.9	
	DEG F		674.3	715.7	757.1	
1000.HZ	DEG K		670.0	698.0	731.0	
	DEG C		376.9	404.9	437.9	
	DEG F		710.3	760.7	820.1	


COATING S1-B
YOUNG'S
Temperature (deg K)
690 650 620 590 570 550 530 510
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5 E4 E3 E2 E1 E0 E−1 E−2 E−3 E−4
FREQUENCY (Hz)
E7 E6 E5 E4 E3 E2 E1 E0 E−1 E−2
E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21
REDUCED FREQUENCY (Hz)

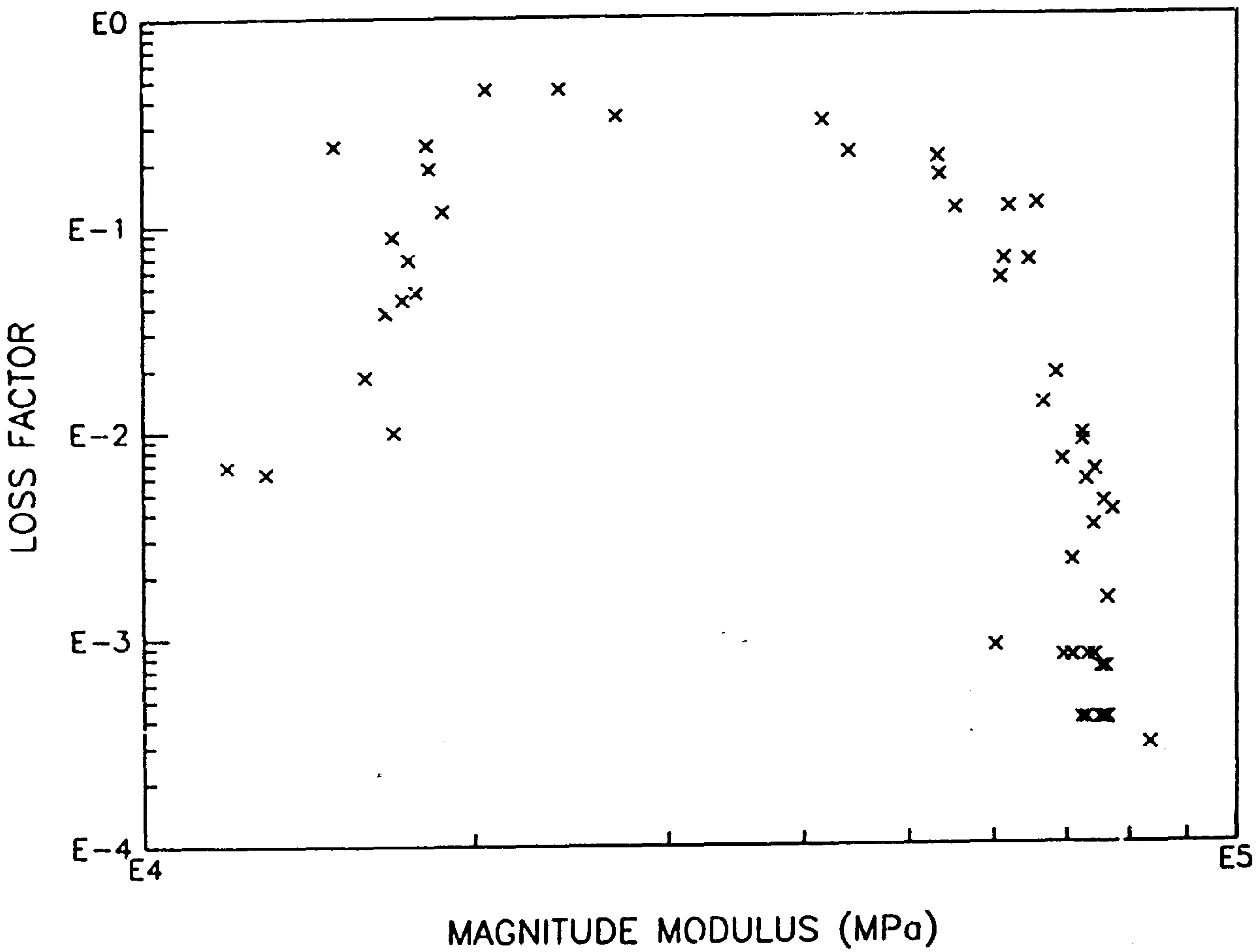
COATING S1-B

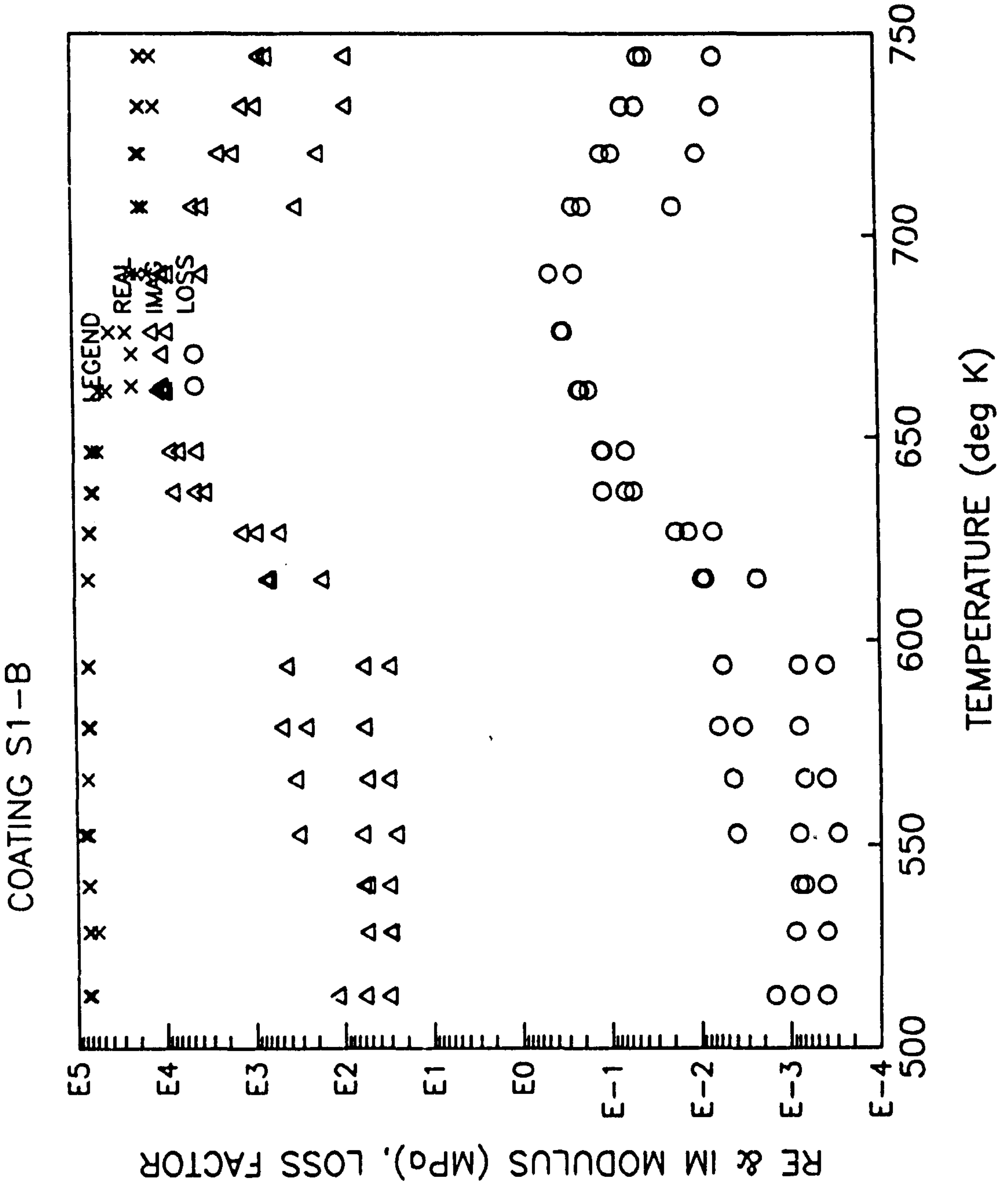
YOUNG'S



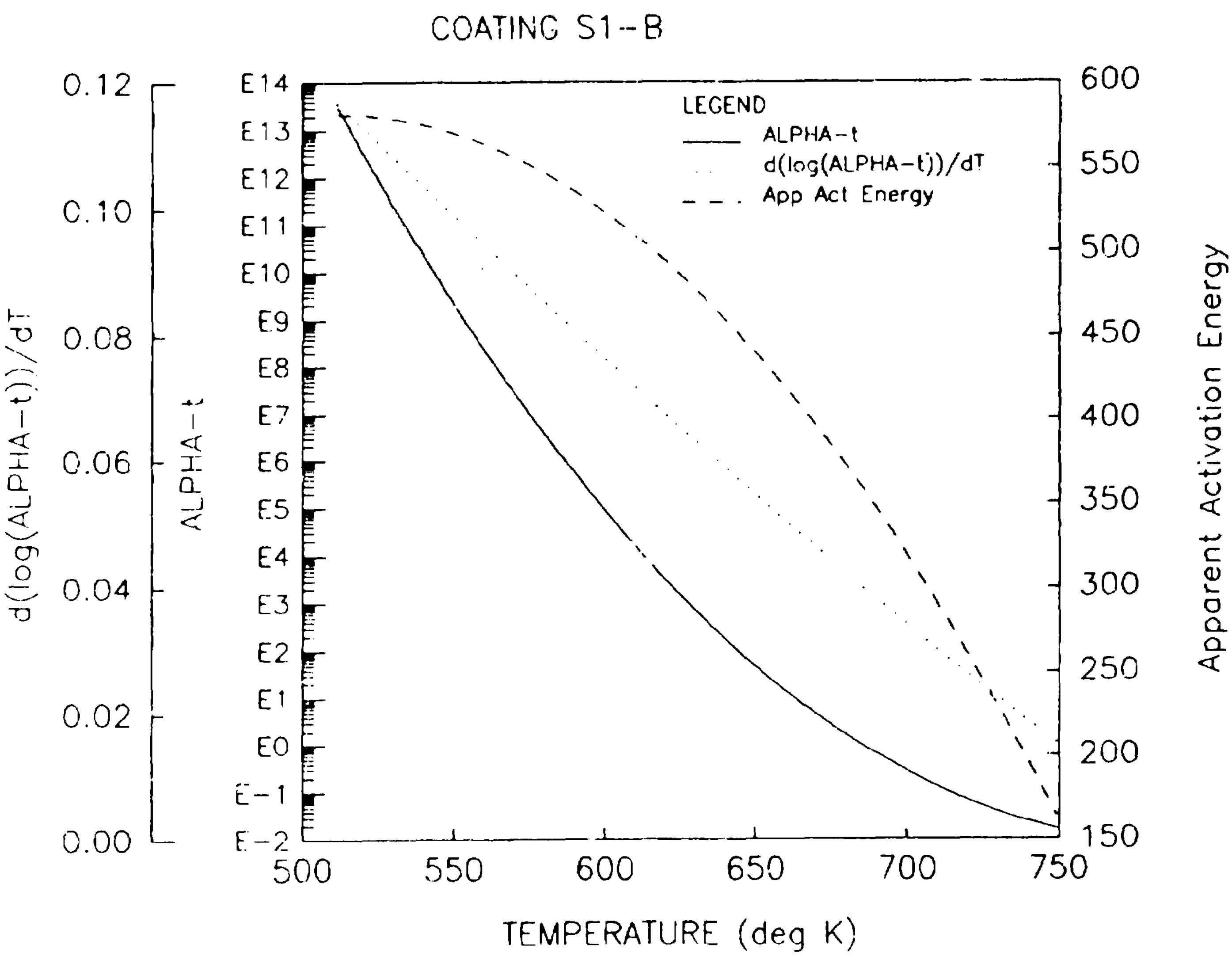

COATING S1-B
E3
E2
E1
FREQUENCY (Hz)
500
550
600
650
700
750
TEMPERATURE (deg K)
450
500
550
600
650
700
750
800
850
TEMPERATURE (deg F)

COATING S1-B





COATING S1-B
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
500
550
600
650
700
750
TEMPERATURE (deg K)


COATING S1-B
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.12
0.10
0.08
0.06
0.04
0.02
0.00
ALPHA-t
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
500
550
600
650
700
750
TEMPERATURE (deg K)
600
550
500
450
400
350
300
250
200
150
Apparent Activation Energy

COATING 51-B YOUNG'S

ALFA-T MODEL

NALP	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	685.0	510.0	750.0	0.4000E-01	0.1173	0.1500E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.1200E+05	0.8000E+05	3000.	0.6000	1.500	0.1200

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

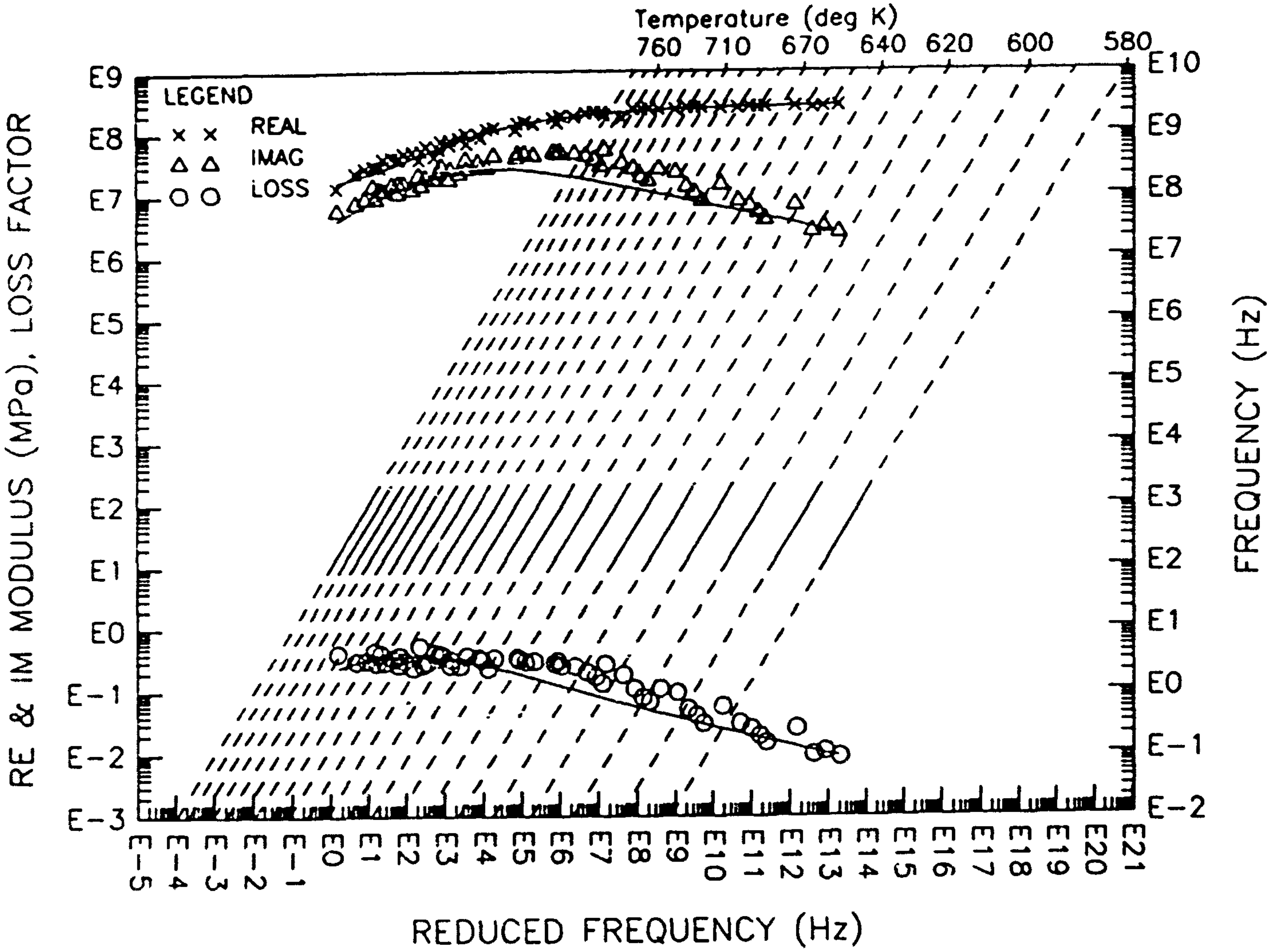
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
512.6	81.00	0.7090E+05	0.8000E-03	56.72
512.6	229.0	0.7630E+05	0.4000E-03	30.52
512.6	449.0	0.7670E+05	0.1500E-02	114.5
528.2	81.00	0.7220E+05	0.4000E-03	28.88
528.2	228.0	0.7510E+05	0.4000E-03	30.04
528.2	435.0	0.6010E+05	0.9000E-03	54.09
539.9	81.00	0.7320E+05	0.8000E-03	58.56
539.9	228.0	0.7600E+05	0.7000E-03	53.20
539.9	447.0	0.7600E+05	0.4000E-03	30.40
552.6	81.00	0.7420E+05	0.8000E-03	59.36
552.6	228.0	0.7710E+05	0.4000E-02	308.4
552.6	452.0	0.8340E+05	0.3000E-03	25.02
566.0	81.00	0.7530E+05	0.7000E-03	52.71
566.0	227.0	0.7570E+05	0.4400E-02	333.1
566.0	445.0	0.7560E+05	0.4000E-03	30.24
578.8	80.00	0.6950E+05	0.8000E-03	55.60
578.8	226.0	0.7430E+05	0.6300E-02	468.1
578.8	443.0	0.7410E+05	0.3400E-02	251.9
593.8	80.00	0.7070E+05	0.8000E-03	56.56
593.8	225.0	0.7300E+05	0.5600E-02	408.8
593.8	441.0	0.7290E+05	0.4000E-03	29.16
614.9	80.00	0.7240E+05	0.9400E-02	680.6
614.9	438.0	0.7080E+05	0.2300E-02	162.8
626.5	79.00	0.6650E+05	0.1320E-01	877.8
626.5	222.0	0.6840E+05	0.1840E-01	1259.
626.5	436.0	0.6930E+05	0.7000E-02	485.1
636.5	78.00	0.6070E+05	0.5340E-01	3241.
636.5	220.0	0.6440E+05	0.6530E-01	4205.
636.5	429.0	0.6150E+05	0.1180	7257.
646.5	77.00	0.5490E+05	0.1169	6418.
646.5	220.0	0.6520E+05	0.1226	7994.
646.5	428.0	0.6110E+05	0.6610E-01	4039.
661.5	75.00	0.4310E+05	0.2194	9456.
661.5	214.0	0.5220E+05	0.2052	0.1071E+05
661.5	420.0	0.5270E+05	0.1680	8854.
676.0	72.00	0.2550E+05	0.3325	8479.
676.0	408.0	0.3980E+05	0.3133	0.1247E+05
690.4	70.00	0.1450E+05	0.2395	3473.
690.4	198.0	0.1870E+05	0.4503	8421.
690.4	391.0	0.2180E+05	0.4491	9790.

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
707.1	70.00	0.1590E+05	0.1840E-01	292.6
707.1	197.0	0.1790E+05	0.1873	3353.
707.1	386.0	0.1760E+05	0.2432	4280.
720.4	70.00	0.1690E+05	0.99[illegible]E-02	167.3
720.4	198.0	0.1680E+05	0.86[illegible]E-01	1460.
720.4	386.0	0.1860E+05	0.11	2145.
732.1	69.00	0.1190E+05	0.6800E-02	80.92
732.1	198.0	0.1770E+05	0.4710E-01	833.7
732.1	384.0	0.1740E+05	0.6720E-01	1169.
744.3	69.00	0.1290E+05	0.6300E-02	81.27
744.3	195.0	0.1660E+05	0.3740E-01	620.8
744.3	383.0	0.1720E+05	0.4330E-01	744.8
614.9	224.0	0.7230E+05	0.8700E-02	629.0

UDRI 385-14 YOUNG'S

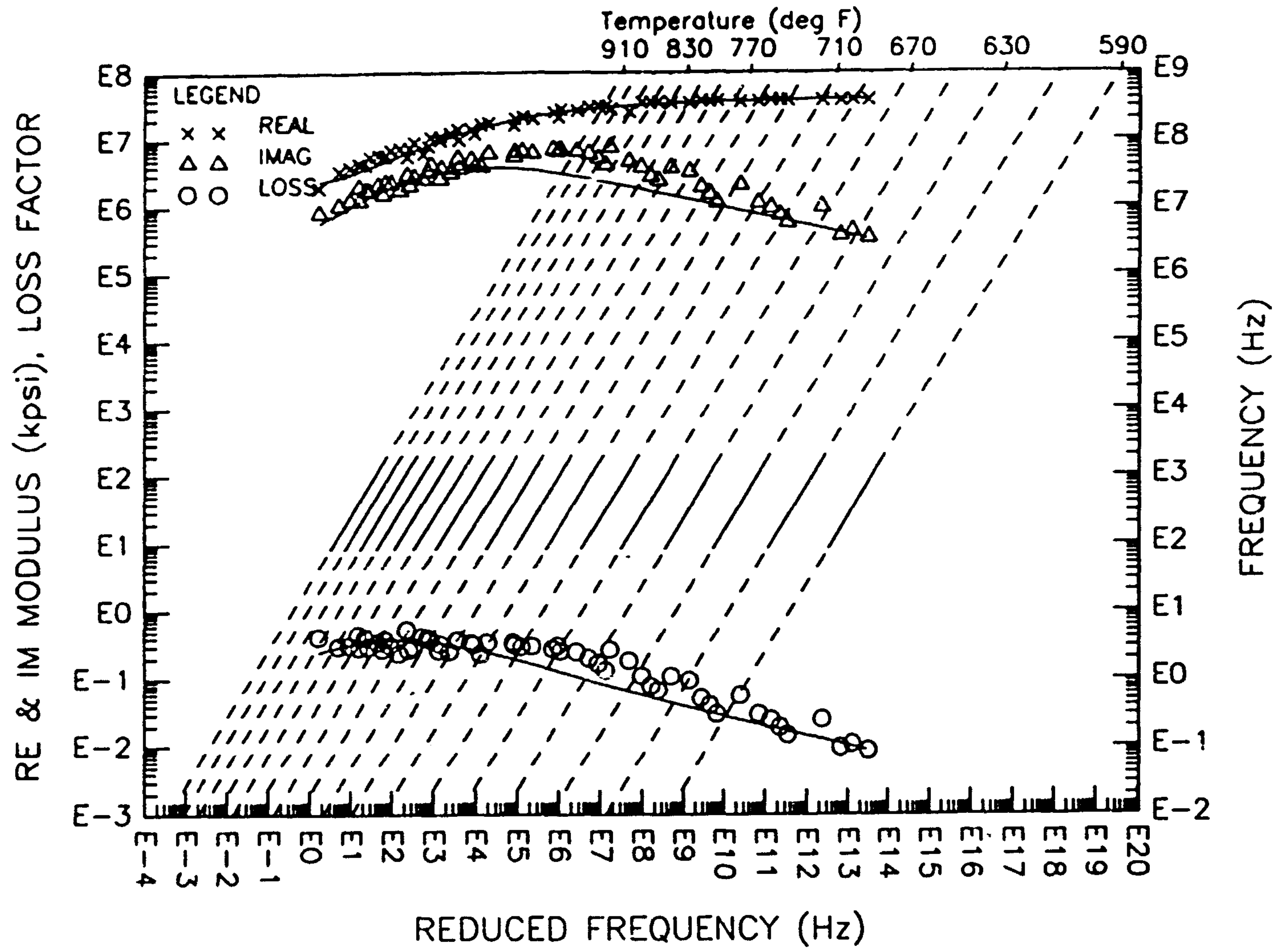
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.8833E-02	0.2634	0.3763	0.2634	0.2432
MODULUS	MPA	0.2697E+09	0.1013E+09	0.3828E+08	0.1718E+08	0.1601E+08
	PSI	0.3912E+11	0.1469E+11	0.5552E+10	0.2492E+10	0.2322E+10
10.HZ	DEG K		660.0	695.0	736.0	
	DEG C		366.9	401.9	442.9	
	DEG F		692.3	755.3	829.1	
100.HZ	DEG K		676.0	718.0	767.0	
	DEG C		382.9	424.9	473.9	
	DEG F		721.1	796.7	884.9	
1000.HZ	DEG K		636.0	745.6	780.0	
	DEG C		402.9	451.9	486.9	
	DEG F		757.1	845.3	908.3	

UDRI J85-14 YOUNG'S

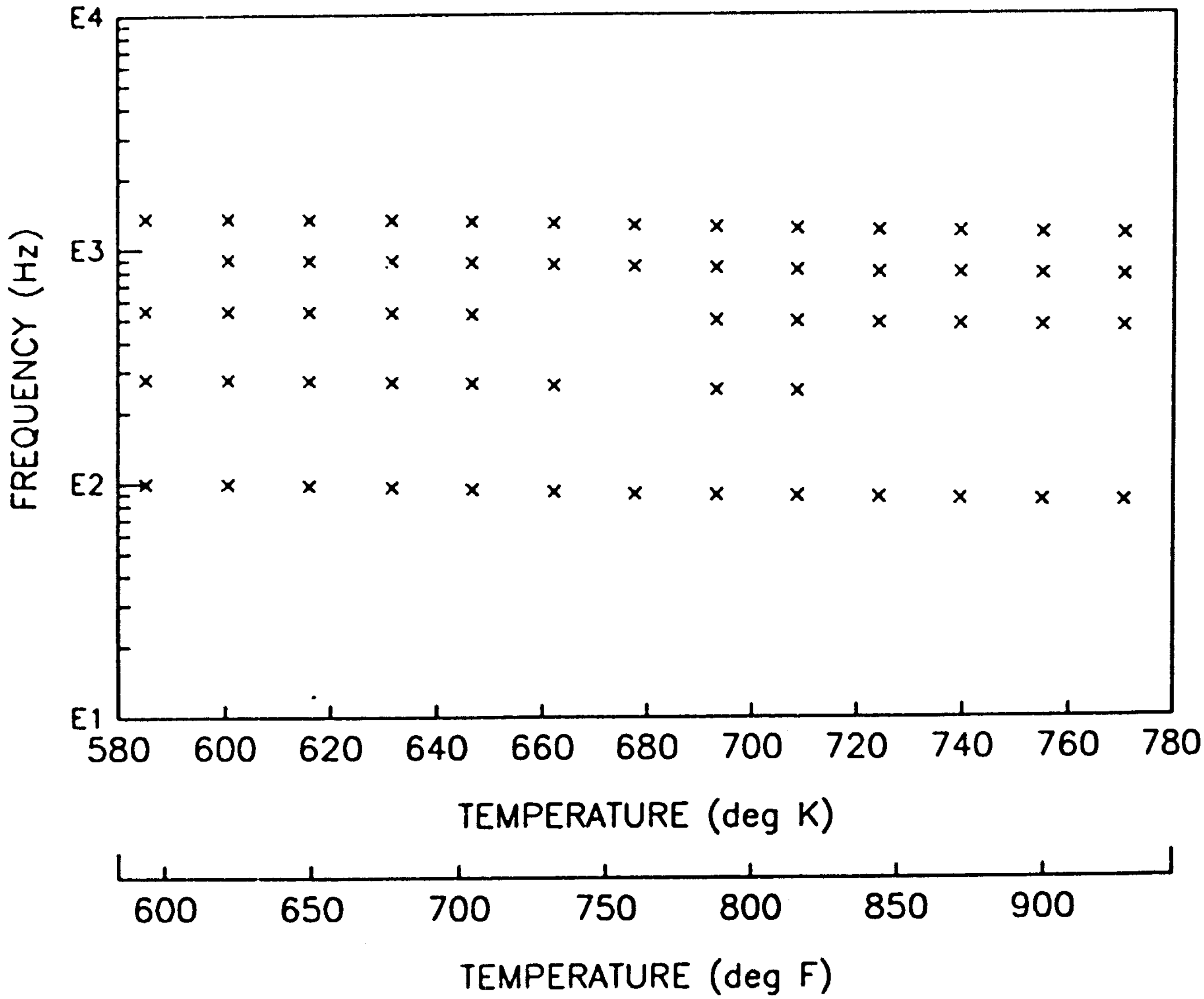


UDRI J85-14

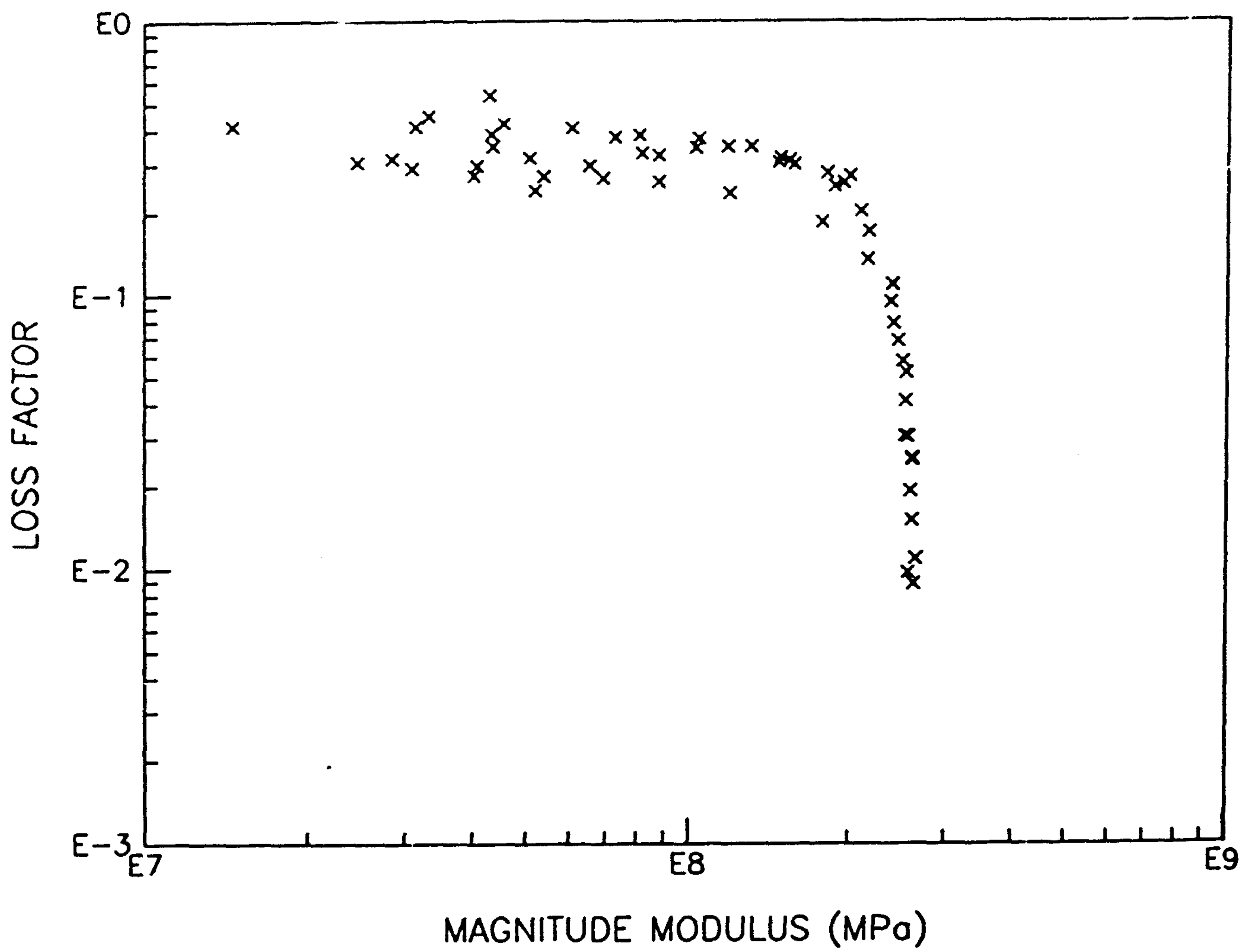
YOUNG'S



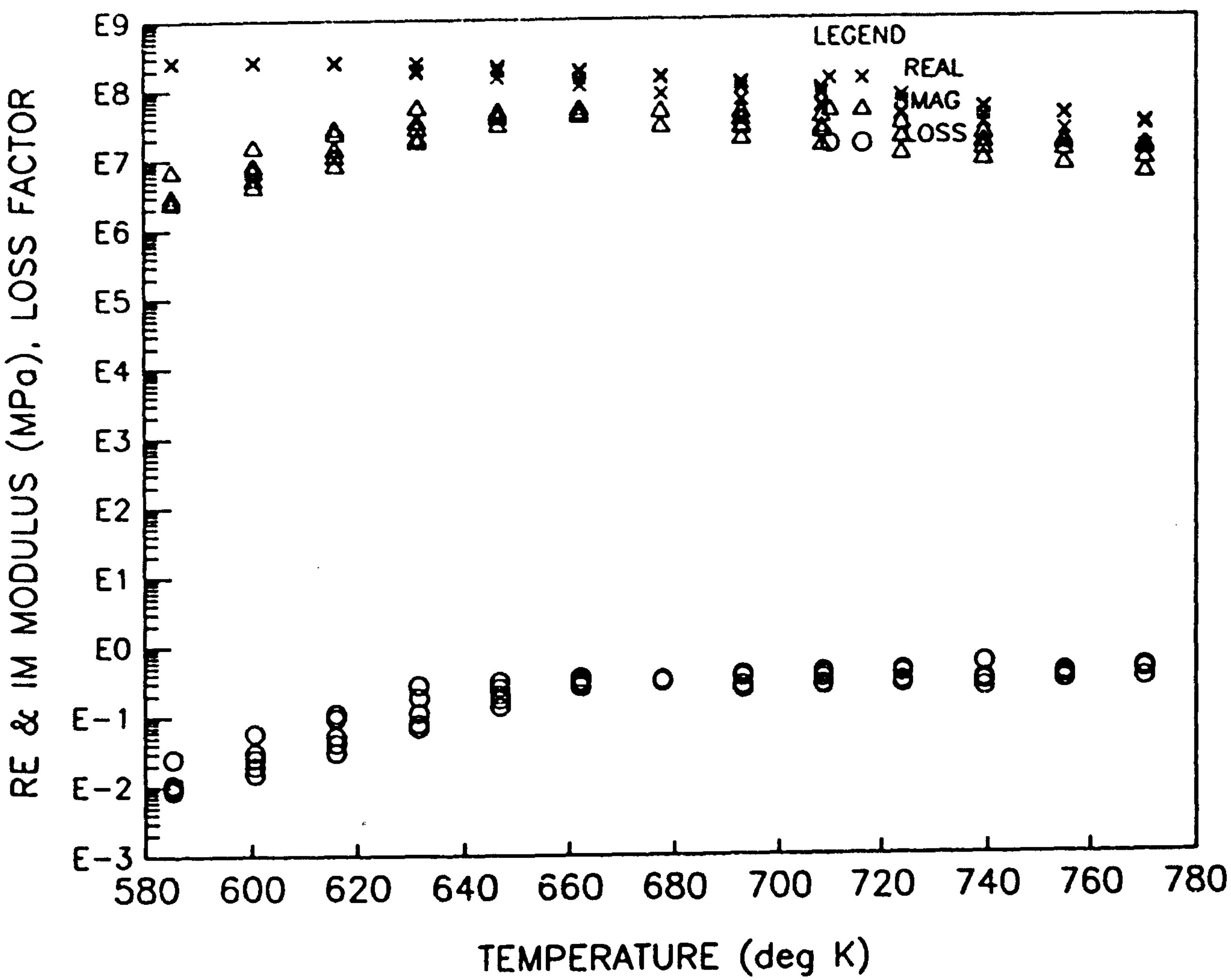
UDRI J85-14


E4
E3
E2
E1
FREQUENCY (Hz)
580
600
620
640
660
680
700
720
740
760
780
TEMPERATURE (deg K)
600
650
700
750
800
850
900
TEMPERATURE (deg F)

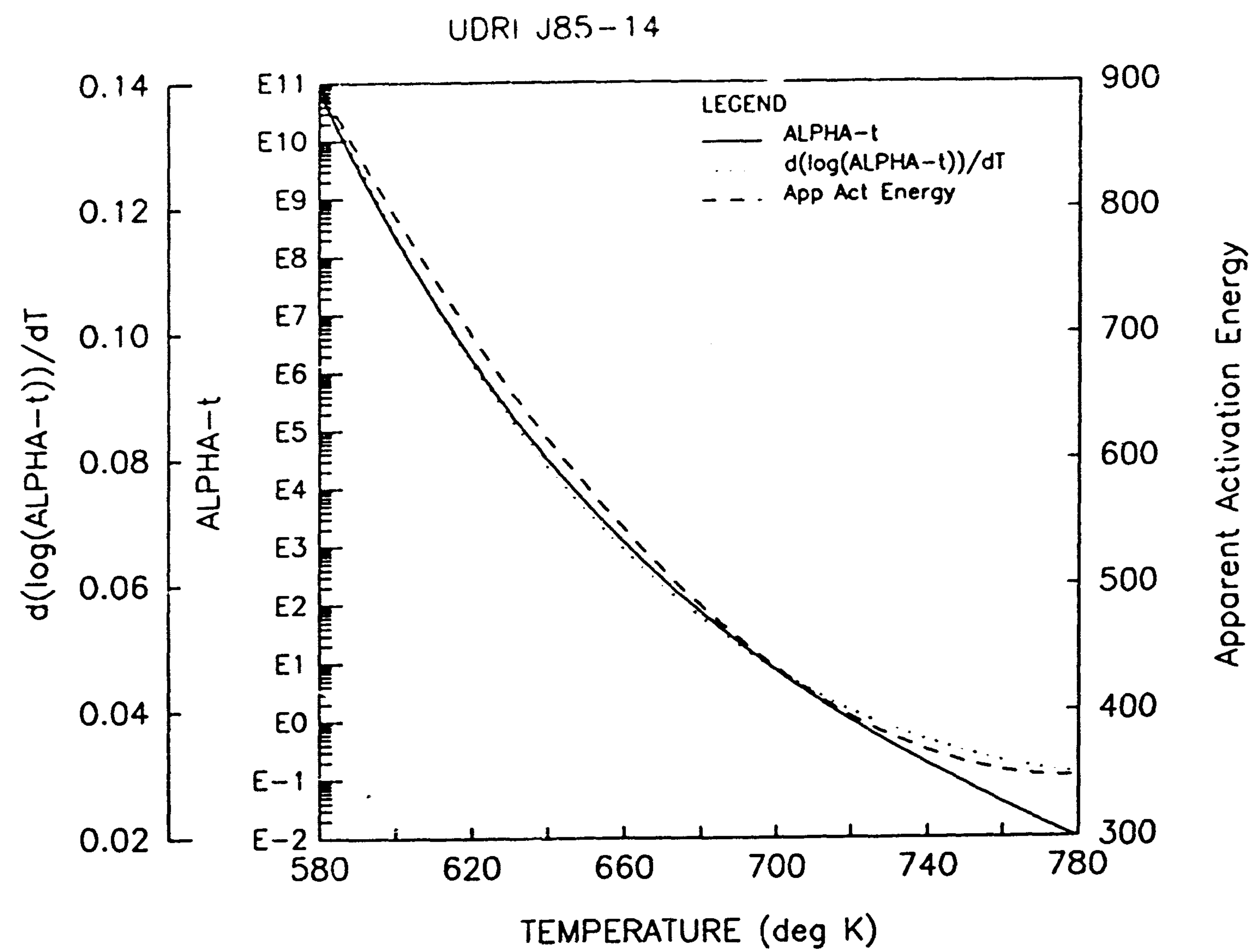
UDRI J85-14



UDRI J85-14



LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E−1
E−2
E−3
580
600
620
640
660
680
700
720
740
760
780
TEMPERATURE (deg K)



UDRI J85-14
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
0.14
0.12
0.10
0.08
0.06
0.04
0.02
d(log(ALPHA-t))/dT
ALPHA-t
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
900
800
700
600
500
400
300
Apparent Activation Energy
580
620
660
700
740
780
TEMPERATURE (deg K)

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	720.0	580.0	780.0	0.4000E-01	0.1400	0.3000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.1000E+08	0.2700E+09	0.1000E+05	0.4000	1.000	0.1500

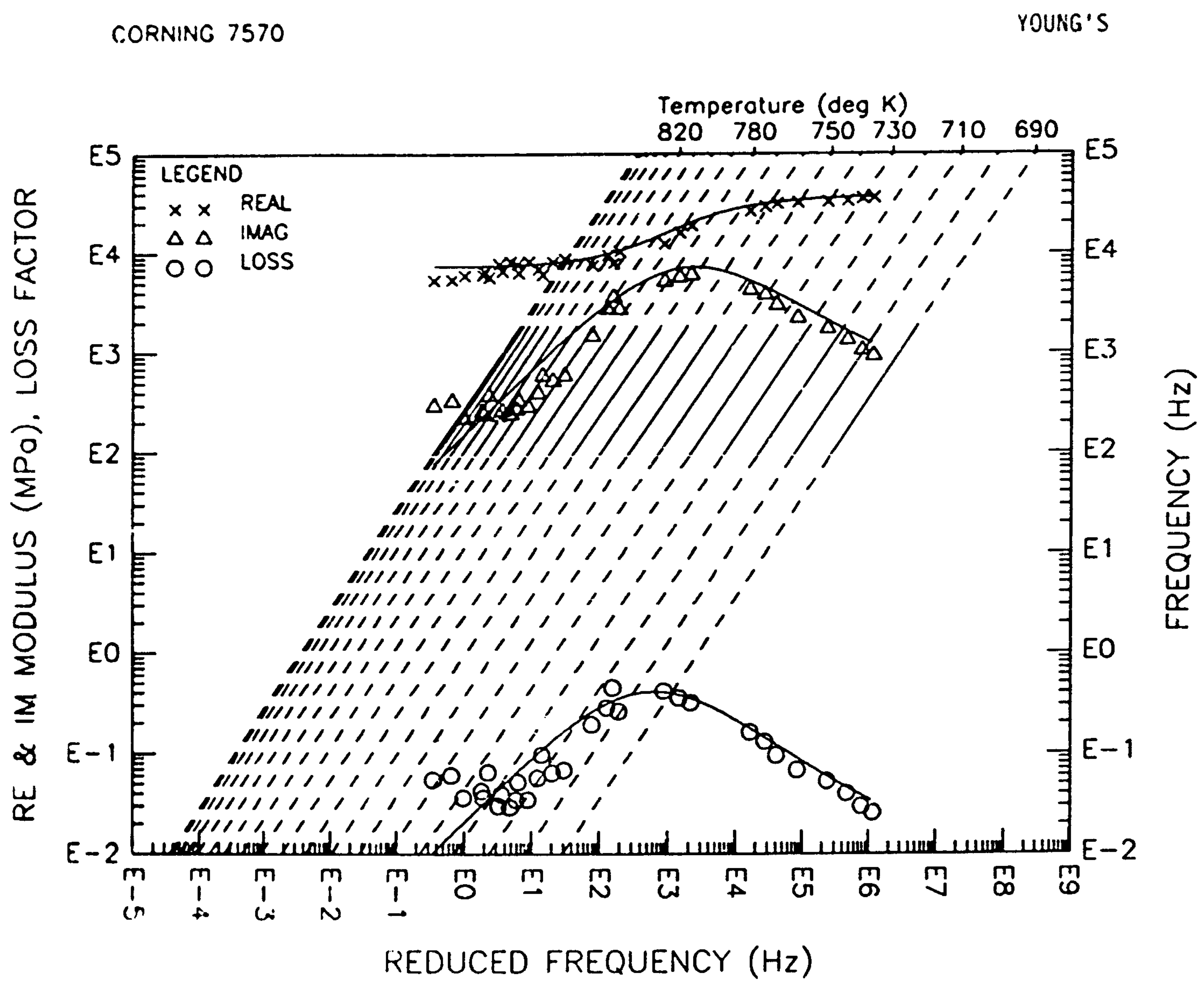
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
770.2	82.80	0.1328E+08	0.4151	0.5513E+07
770.2	459.8	0.2704E+08	0.3155	0.8531E+07
770.2	763.8	0.3018E+08	0.4488	0.1354E+08
770.2	1142.	0.2891E+08	0.4124	0.1192E+08
754.8	1157.	0.4033E+08	0.3852	0.1554E+08
754.8	773.7	0.4116E+08	0.3477	0.1431E+08
754.8	83.90	0.2342E+08	0.3054	0.7152E+07
739.3	84.90	0.2956E+08	0.2903	0.8581E+07
739.3	472.4	0.4853E+08	0.3168	0.1537E+08
739.3	783.3	0.5065E+08	0.2403	0.1217E+08
739.3	1176.	0.3785E+08	0.5376	0.2035E+08
723.9	1193.	0.7550E+08	0.3840	0.2899E+08
723.9	786.2	0.4207E+08	0.4211	0.1772E+08
723.9	479.1	0.6259E+08	0.2968	0.1858E+08
723.9	86.10	0.3873E+08	0.2728	0.1057E+08
708.5	87.30	0.5196E+08	0.2704	0.1405E+08
708.5	245.2	0.5615E+08	0.4083	0.2293E+08
708.5	485.8	0.7784E+08	0.3299	0.2568E+08
708.5	807.1	0.8515E+08	0.2582	0.2199E+08
708.5	1214.	0.9791E+08	0.3732	0.3654E+08
693.0	1235.	0.1231E+09	0.3477	0.4280E+08
693.0	823.5	0.1159E+09	0.2353	0.2727E+08
693.0	493.5	0.9777E+08	0.3457	0.3380E+08
693.0	248.3	0.6803E+08	0.3771	0.2565E+08
693.0	88.60	0.6681E+08	0.2664	0.1780E+08
677.6	89.80	0.8391E+08	0.3225	0.2706E+08
677.6	837.3	0.1413E+09	0.3172	0.4482E+08
662.1	1283.	0.1892E+09	0.2571	0.4864E+08
662.1	853.6	0.1753E+09	0.2791	0.4893E+08
662.1	259.2	0.1404E+09	0.3062	0.4299E+08
662.1	91.50	0.1117E+09	0.3479	0.3886E+08
646.7	93.40	0.1470E+09	0.3095	0.4551E+08
646.7	265.0	0.1826E+09	0.2498	0.4561E+08
646.7	524.6	0.2063E+09	0.2029	0.4186E+08
646.7	871.2	0.2147E+09	0.1700	0.3650E+08
646.7	1303.	0.2148E+09	0.1345	0.2889E+08
631.3	1324.	0.2457E+09	0.6810E-01	0.1673E+08
631.3	884.2	0.2410E+09	0.7870E-01	0.1897E+08
631.3	533.8	0.2393E+09	0.1097	0.2625E+08
631.3	268.5	0.1749E+09	0.1845	0.3227E+08

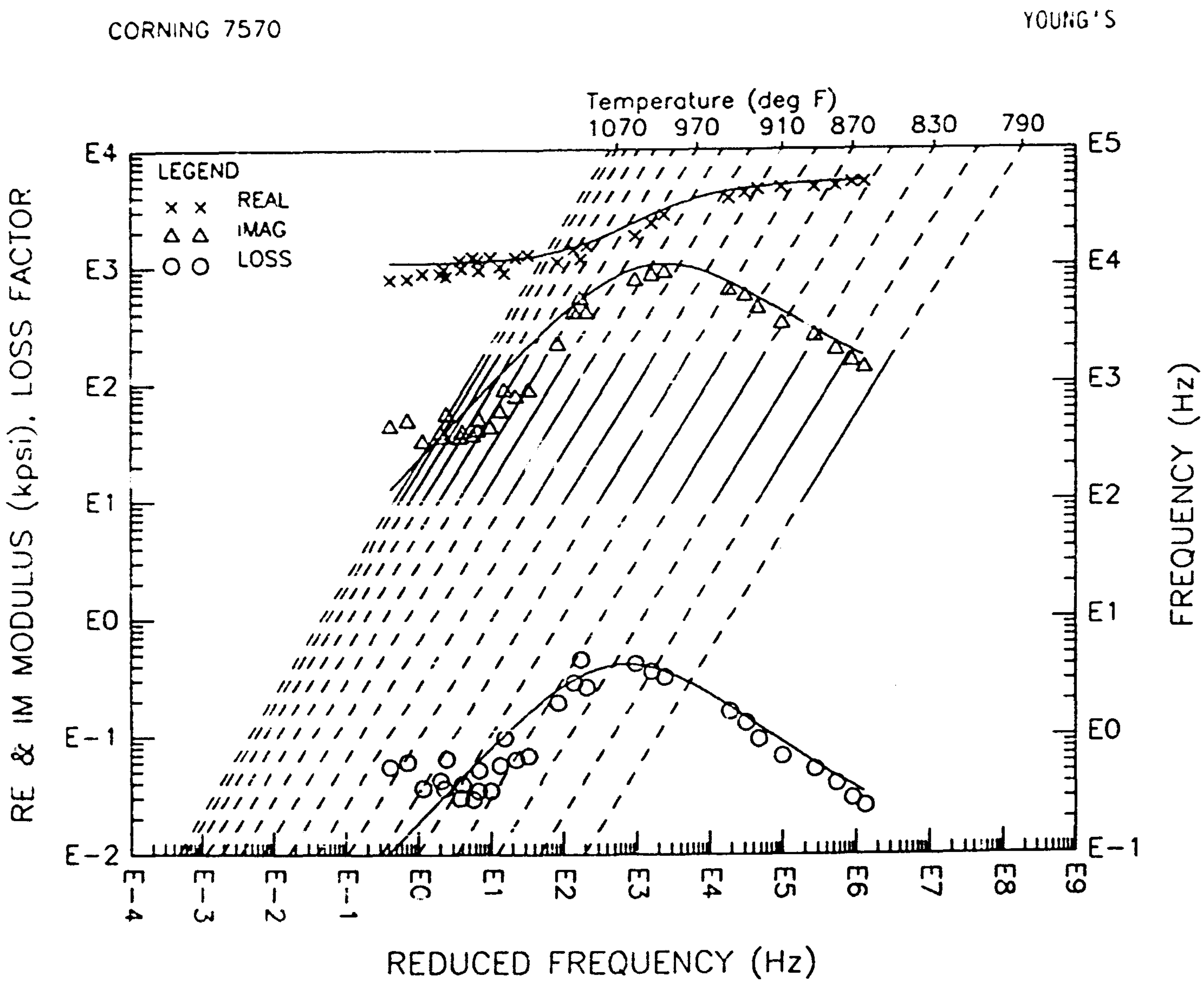
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
631.3	95.60	0.1938E+09	0.2733	0.5297E+08
615.9	97.70	0.2395E+09	0.1089	0.2608E+08
615.9	273.4	0.2379E+09	0.9420E-01	0.2241E+08
615.9	539.7	0.2547E+09	0.5200E-01	0.1324E+08
615.9	893.4	0.2541E+09	0.4090E-01	0.1039E+08
615.9	1337.	0.2568E+09	0.3030E-01	0.7781E+07
600.4	1347.	0.2615E+09	0.1500E-01	0.3923E+07
600.4	900.5	0.2598E+09	0.1920E-01	0.4988E+07
600.4	544.1	0.2616E+09	0.2490E-01	0.6514E+07
600.4	276.3	0.2533E+09	0.30[illegible]0E-01	0.7726E+07
600.4	98.70	0.2512E+09	0.5730E-01	0.1439E+08
585.0	99.60	0.2619E+09	0.2530E-01	0.6626E+07
585.0	278.4	0.2569E+09	0.9700E-02	0.2492E+07
585.0	548.2	0.2651E+09	0.1090E-01	0.2890E+07
585.0	1356.	0.2629E+09	0.8800E-02	0.2314E+07
754.8	466.4	0.3895E+08	0.2976	0.1159E+08
677.6	1257.	0.1506E+09	0.2996	0.4512E+08
677.6	1257.	0.1506E+09	0.2996	0.4512E+08

CORNING 7570 YOUNG'S

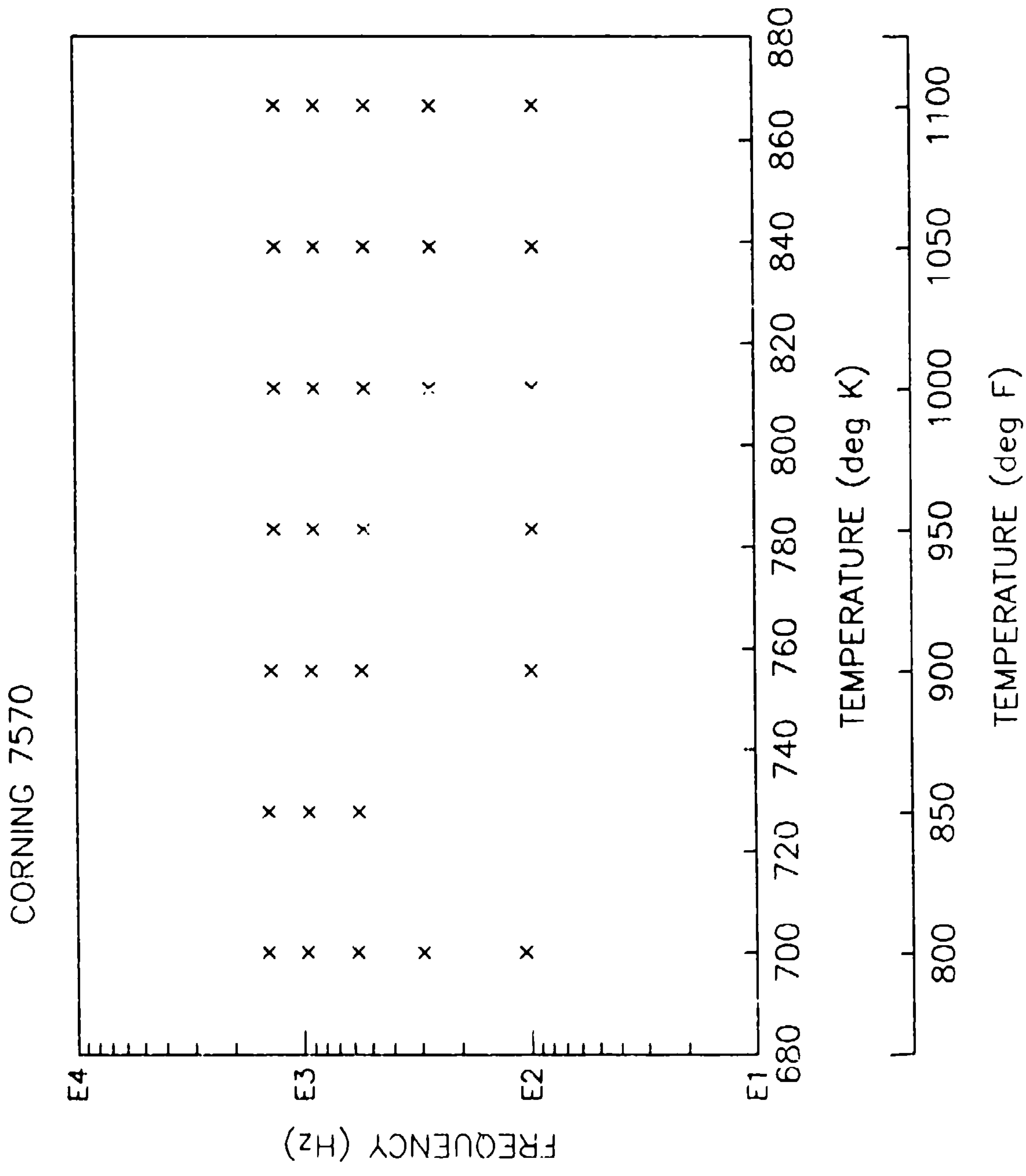
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.3329E-01	0.2847	0.4068	0.2847	0.1046E-01
MODULUS	MPA	0.3678E+05	0.2455E+05	0.1434E+05	9549.	7400.
	PSI	0.5335E+07	0.3560E+07	0.2080E+07	0.1385E+07	0.1073E+07
	DEG K		704.0	721.0	737.0	
10.HZ	DEG C		410.9	427.9	443.9	
	DEG F		771.5	802.1	830.9	
	DEG K		723.0	742.0	760.0	
100.HZ	DEG C		429.9	448.9	466.9	
	DEG F		805.7	839.9	872.3	
	DEG K		744.0	765.0	788.0	
1000.HZ	DEG C		450.9	471.9	494.9	
	DEG F		843.5	881.3	922.7	

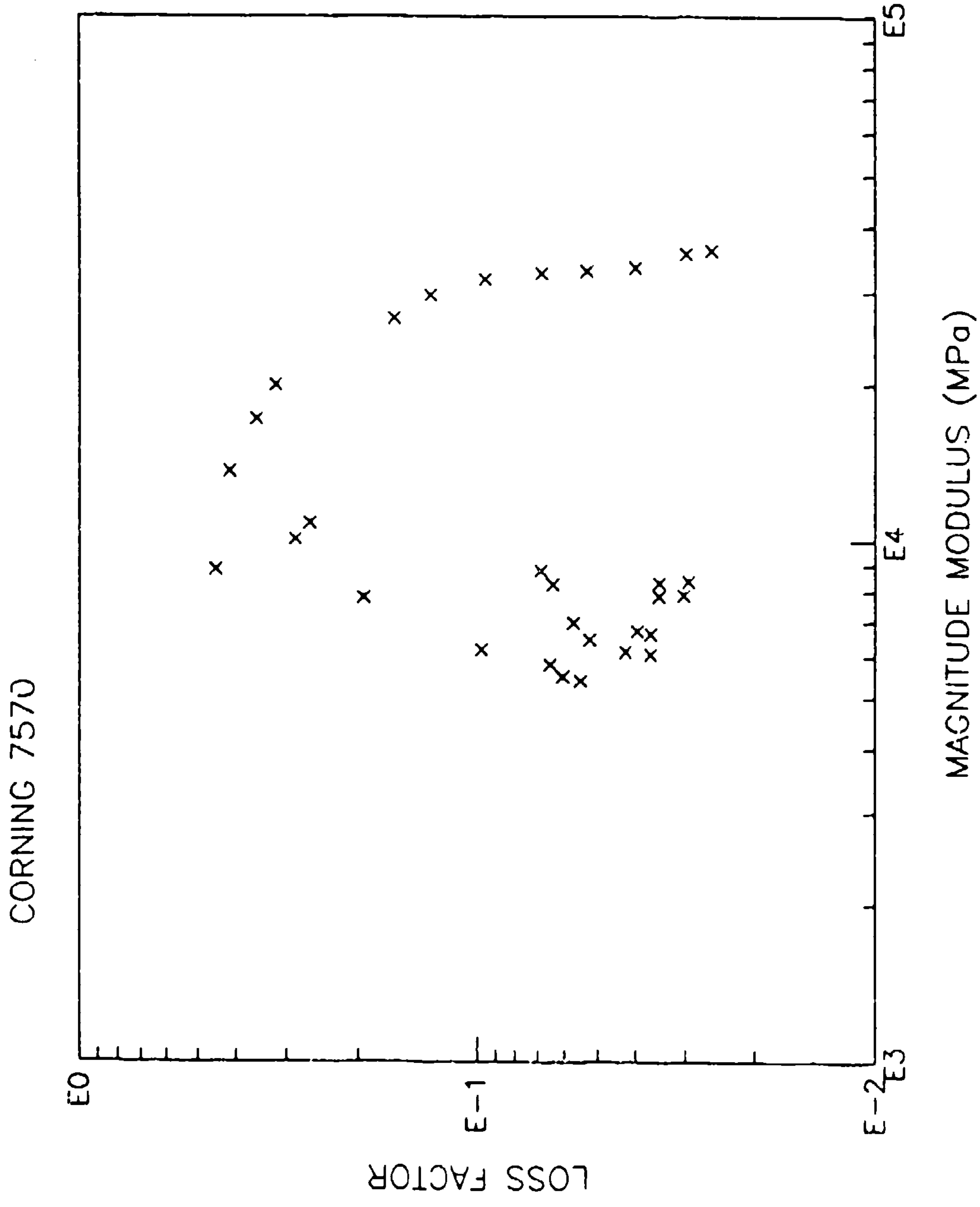


CORNING 7570
YOUNG'S
Temperature (deg K)
820 780 750 730 710 690
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5 E4 E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9
REDUCED FREQUENCY (Hz)

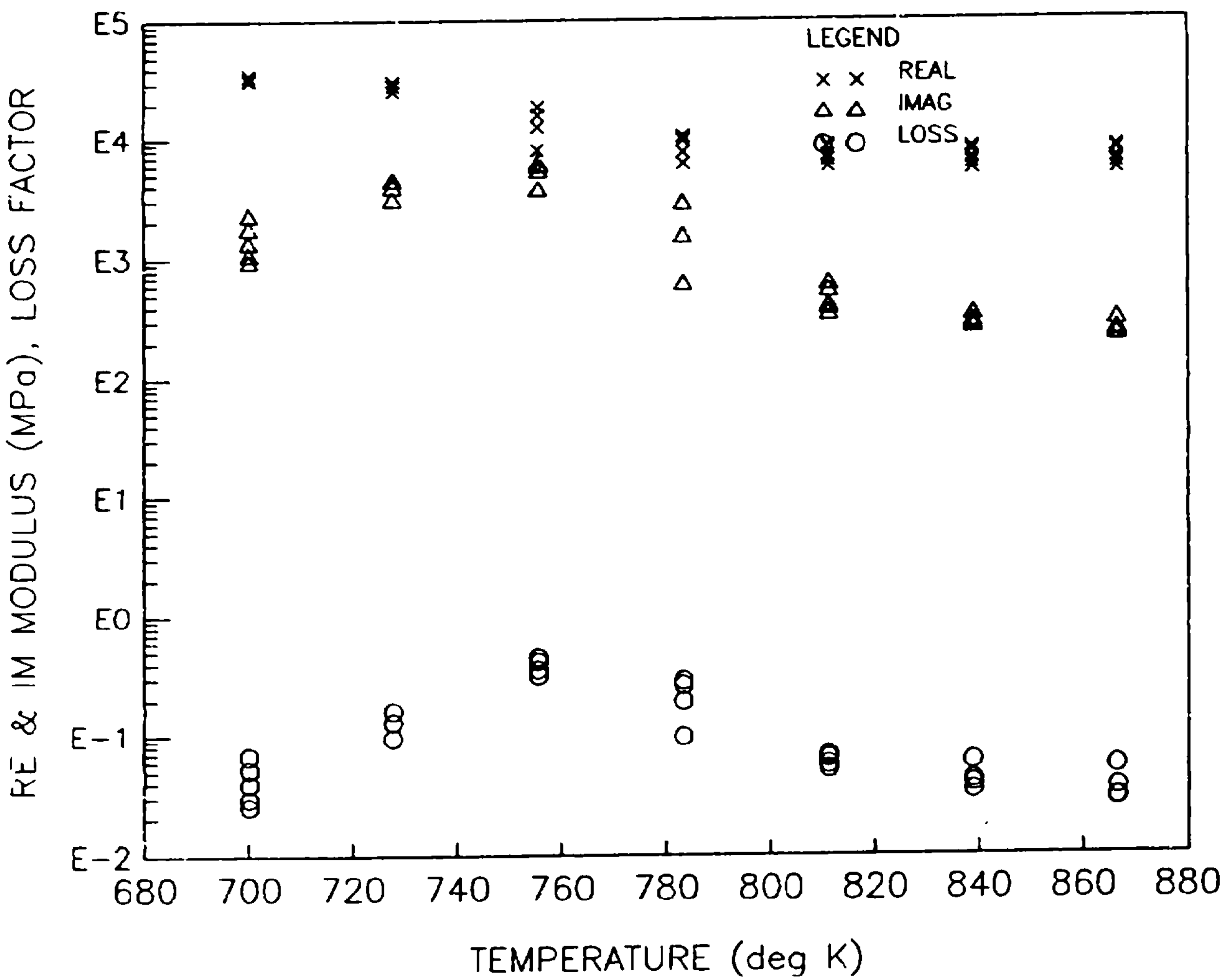


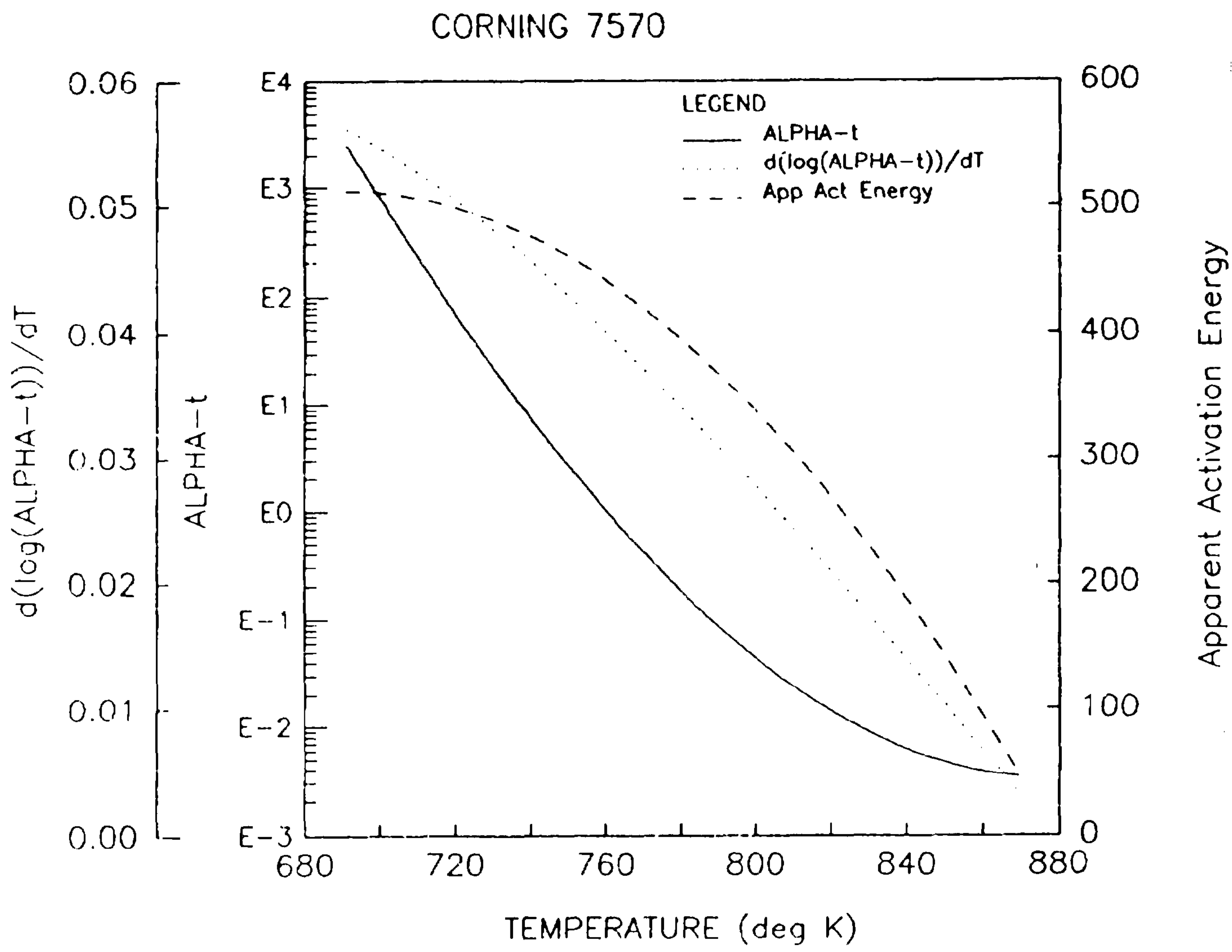
CORNING 7570
YOUNG'S
Temperature (deg F)
1070 970 910 870 830 790
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
E4
E3
E2
E1
E0
E−1
E−2
RE & IM MODULUS (kpsi), LOSS FACTOR
E5
E4
E3
E2
E1
E0
E−1
FREQUENCY (Hz)
E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9
REDUCED FREQUENCY (Hz)


CORNING 7570
FREQUENCY (Hz)
E4
E3
E2
E1
680
700
720
740
760
780
800
820
840
860
880
TEMPERATURE (deg K)
800
850
900
950
1000
1050
1100
TEMPERATURE (deg F)


CORNING 7570
LOSS FACTOR
MAGNITUDE MODULUS (MPa)
E0
E-1
E-2
E3
E4
E5

CORNING 7570




CORNING 7570
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
0.06
0.05
0.04
0.03
0.02
0.01
0.00
d(log(ALPHA-t))/dT
ALPHA-t
E4
E3
E2
E1
E0
E-1
E-2
E-3
680
720
760
800
840
880
TEMPERATURE (deg K)
600
500
400
300
200
100
0
Apparent Activation Energy

CORNING 7570 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	760.0	690.0	870.0	0.4000E-01	0.5632E-01	0.3000E-02

COMPLEX MODULUS MODEL

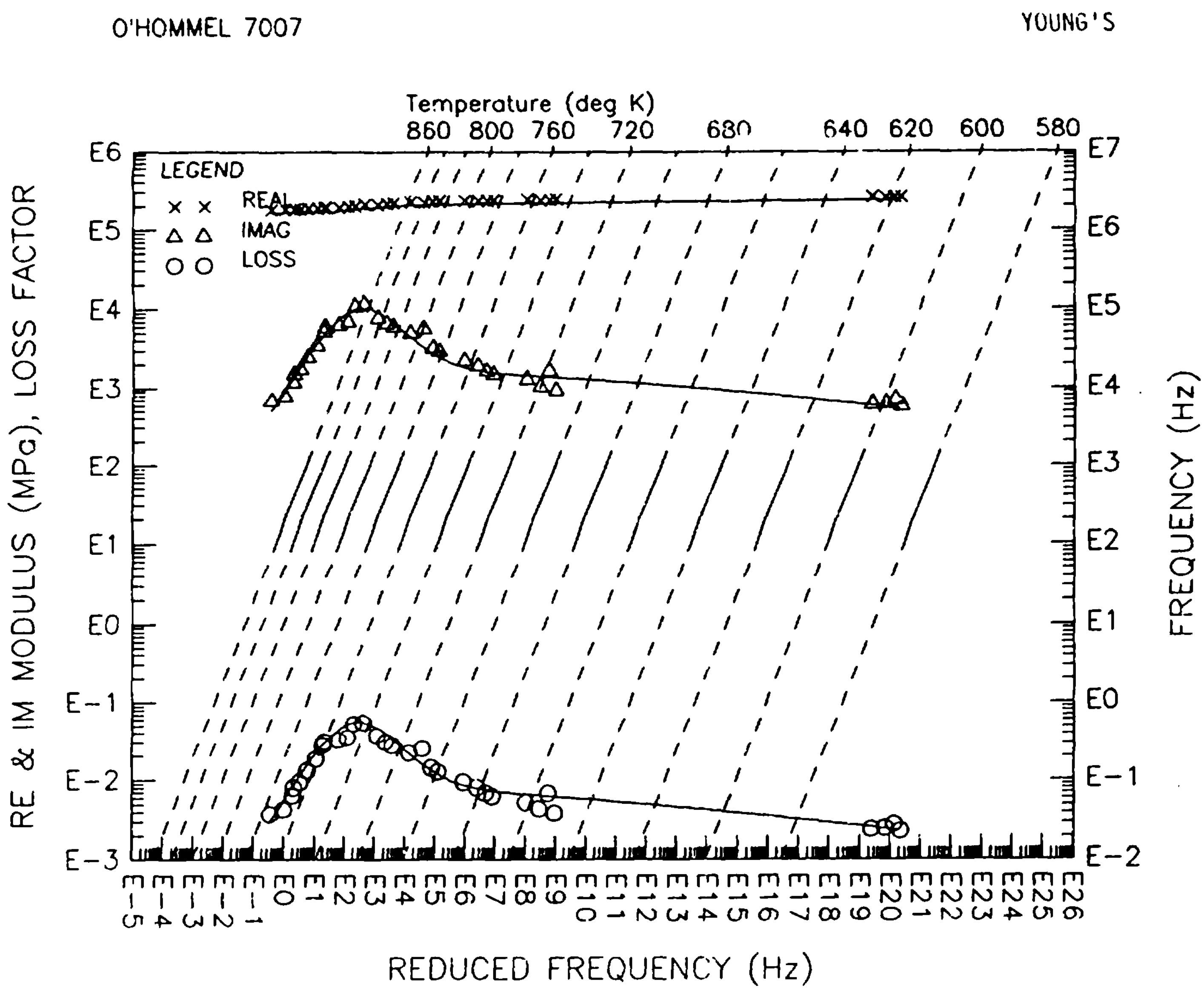
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	7355.	0.3200E+05	2162.	0.6691	0.3944	0.2473

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
866.5	95.50	5360.	0.5490E-01	294.3
866.5	267.9	6020.	0.3660E-01	220.3
866.5	525.9	6590.	0.3650E-01	240.5
866.5	872.3	7820.	0.3020E-01	236.2
866.5	1305.	8320.	0.2940E-01	244.6
838.8	96.20	5450.	0.6060E-01	330.3
838.8	269.8	6090.	0.4250E-01	258.8
838.8	529.5	6670.	0.3950E-01	263.5
838.8	878.0	7800.	0.3480E-01	271.4
838.8	1313.	8270.	0.3480E-01	287.8
811.0	96.80	5750.	0.6510E-01	374.3
811.0	271.6	6420.	0.5210E-01	334.5
811.0	533.0	6930.	0.5720E-01	396.4
811.0	884.1	8200.	0.6400E-01	524.8
811.0	1323.	8720.	0.6850E-01	597.3
783.2	97.50	6120.	0.9730E-01	595.5
783.2	537.0	7600.	0.1940	1474.
783.2	891.9	9640.	0.2859	2756.
783.2	1336.	0.1040E+05	0.2625	2730.
755.4	98.60	7990.	0.4509	3603.
755.4	547.3	0.1250E+05	0.4158	5198.
755.4	913.0	0.1610E+05	0.3564	5738.
755.4	1373.	0.1890E+05	0.3193	6035.
727.6	568.7	0.2630E+05	0.1626	4276.
727.6	946.2	0.2920E+05	0.1307	3816.
727.6	1420.	0.3140E+05	0.9520E-01	2989.
699.9	105.6	0.3240E+05	0.6810E-01	2206.
699.9	295.8	0.3270E+05	0.5290E-01	1730.
699.9	580.4	0.3320E+05	0.4000E-01	1328.
699.9	963.8	0.3530E+05	0.2980E-01	1052.
699.9	1441.	0.3580E+05	0.2570E-01	920.1

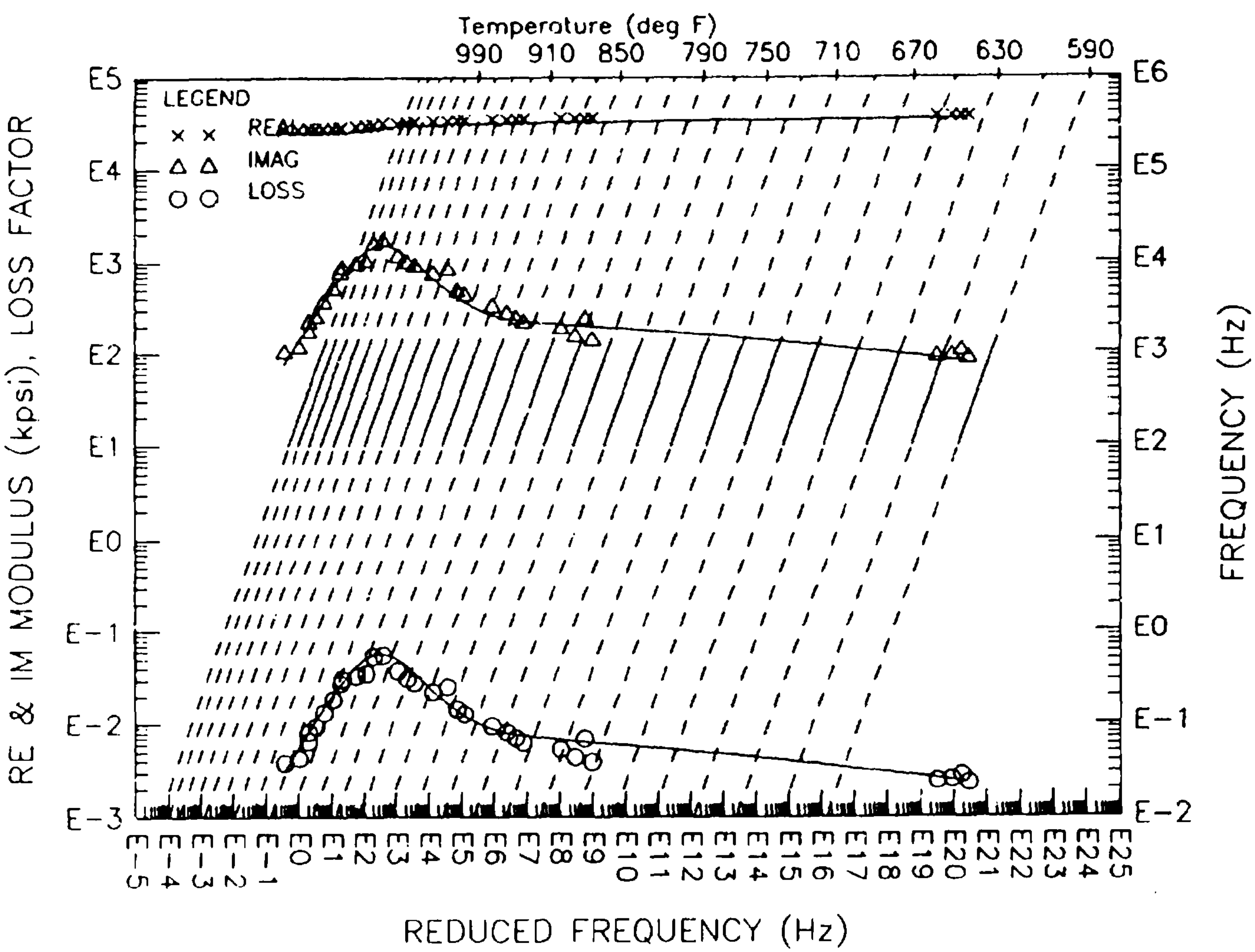
O'HOMMEL 7007 YOUNG'S

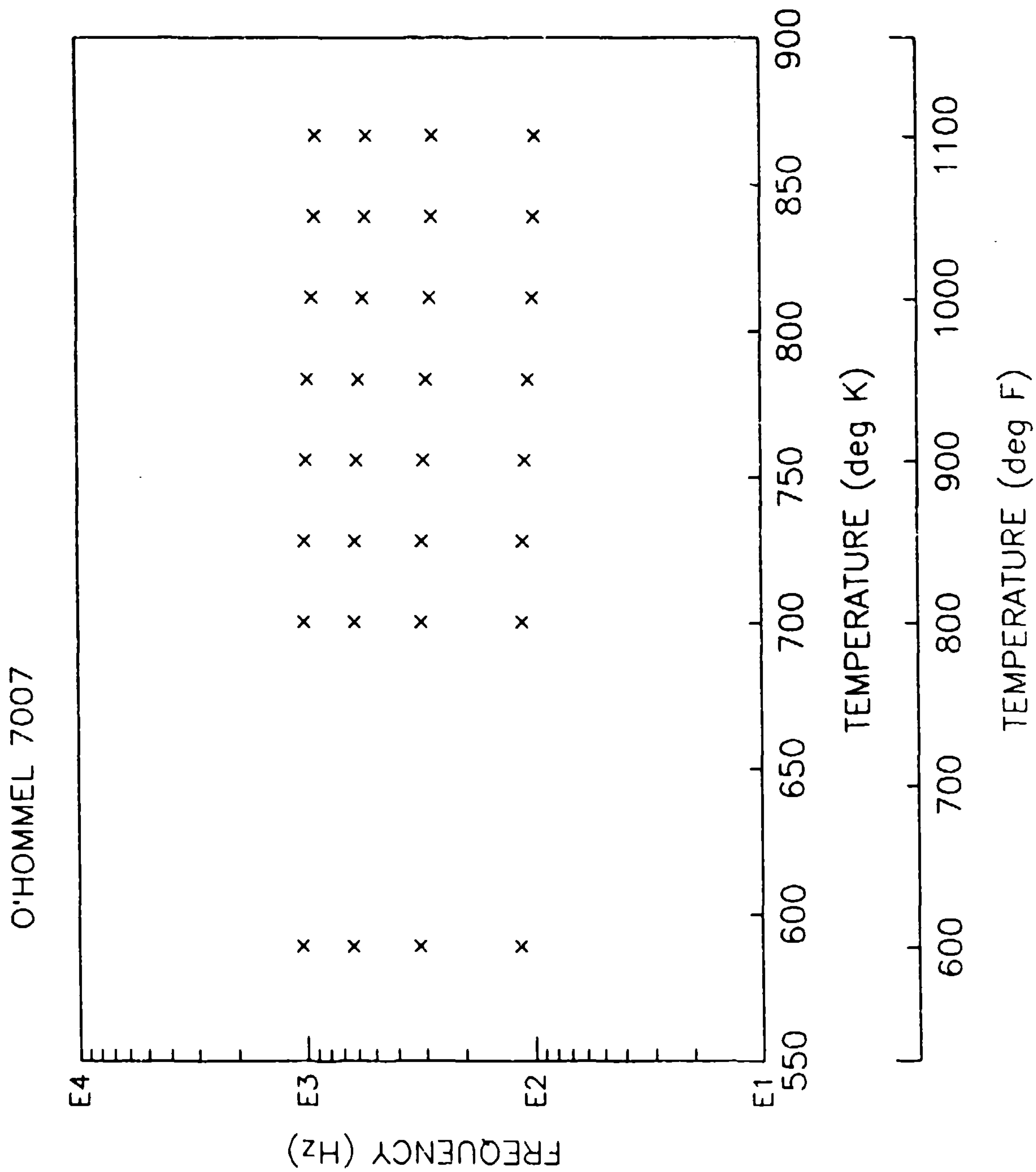
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.2328E-02	0.3921E-01	0.5601E-01	0.3921E-01	0.3048E-02
MODULUS	MPA	0.2339E+06	0.1991E+06	0.1849E+06	0.1726E+06	0.1656E+06
	PSI	0.3392E+08	0.2888E+08	0.2682E+08	0.2503E+08	0.2401E+08
10.HZ	DEG K		750.0	766.0	782.0	
	DEG C		456.9	472.9	488.9	
	DEG F		854.3	883.1	911.9	
100.HZ	DEG K		768.0	786.0	803.0	
	DEG C		474.9	492.9	509.9	
	DEG F		886.7	919.1	949.7	
1000.HZ	DEG K		787.0	808.0	829.0	
	DEG C		493.9	514.9	535.9	
	DEG F		920.9	958.7	996.5	


O'HOMMEL 7007
YOUNG'S
Temperature (deg K)
860 800 760 720 680 640 620 600 580
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E6 E5 E4 E3 E2 E1 E0 E−1 E−2 E−3
E7 E6 E5 E4 E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26
REDUCED FREQUENCY (Hz)

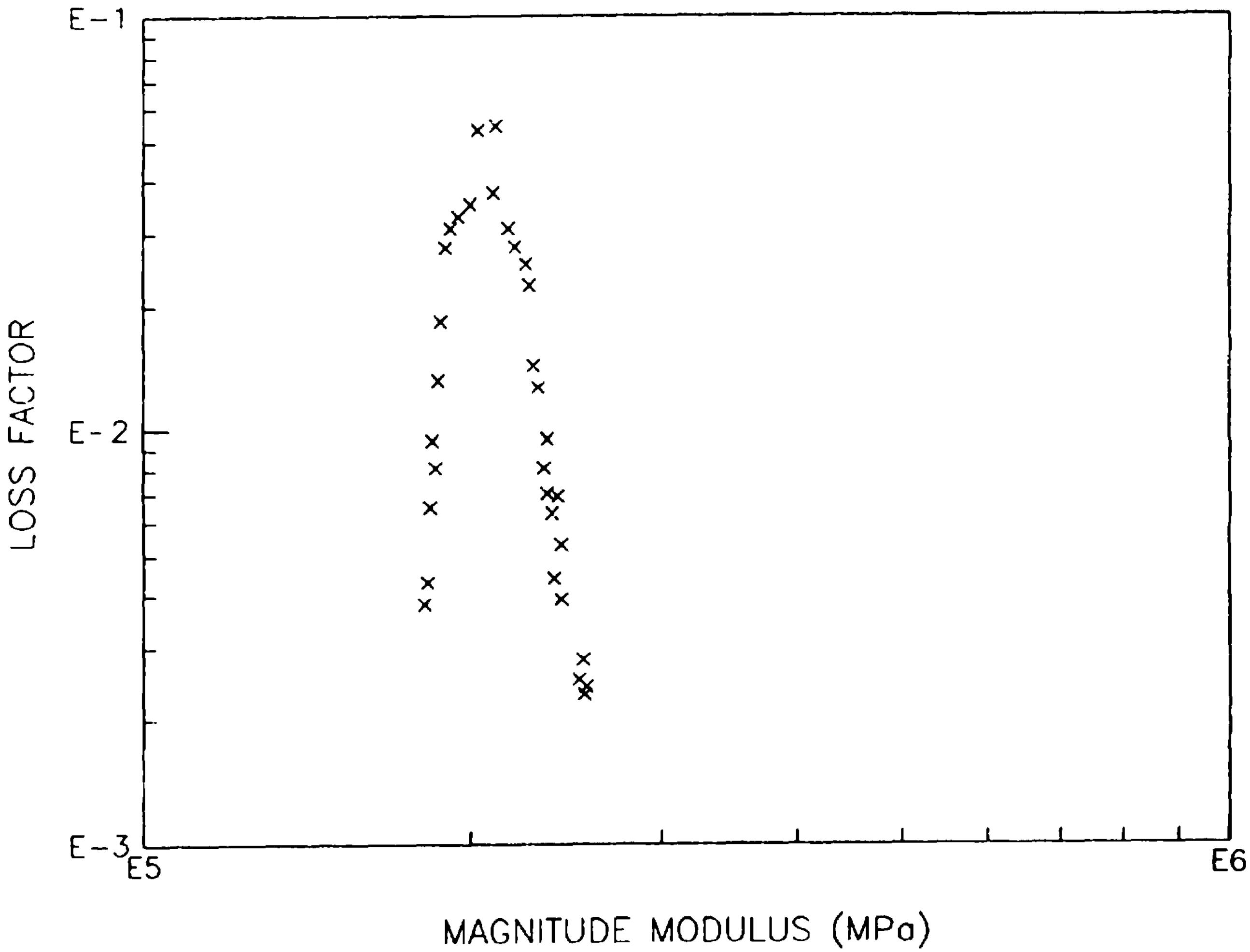
O'HOMMEL 7007

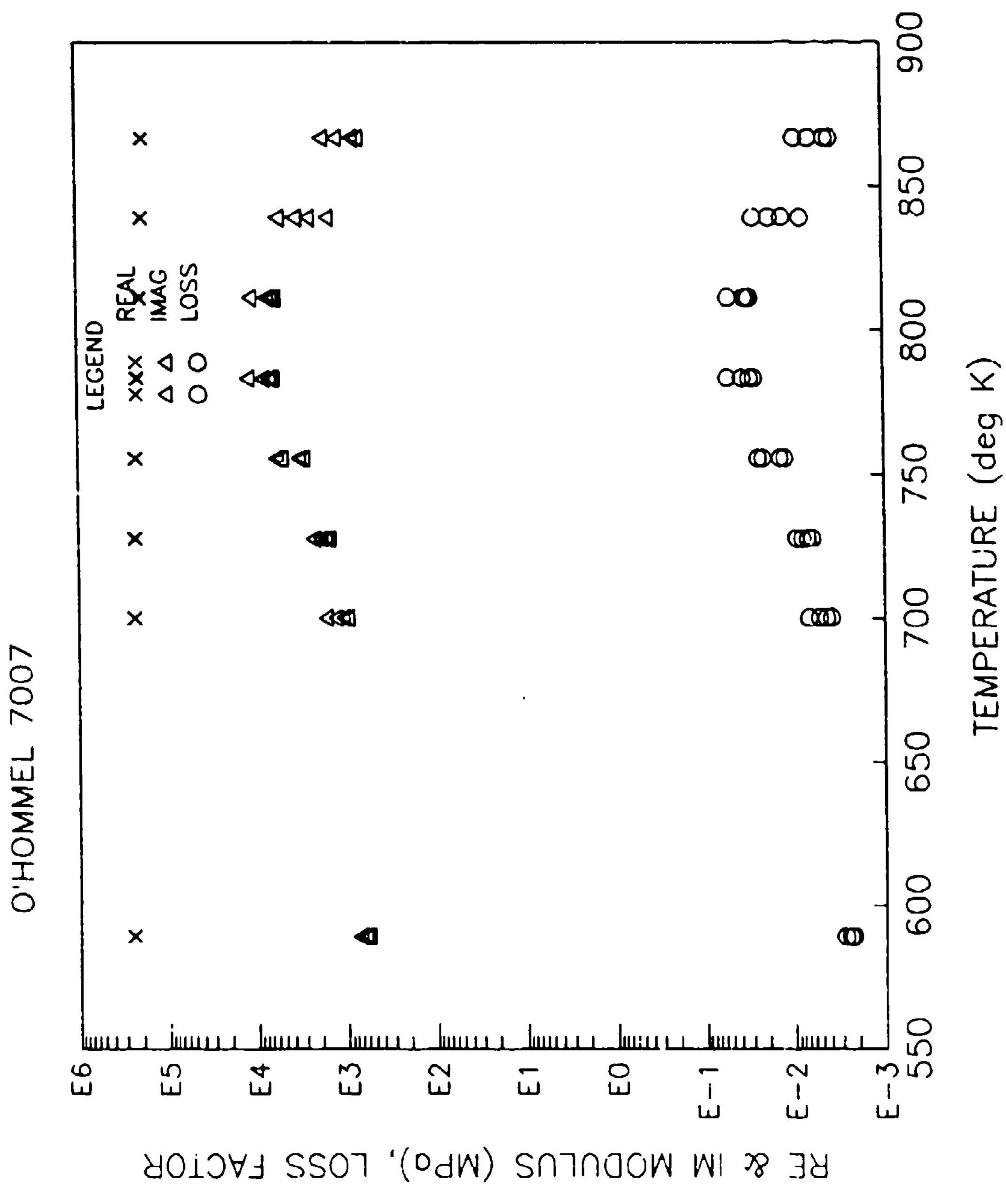
YOUNG'S



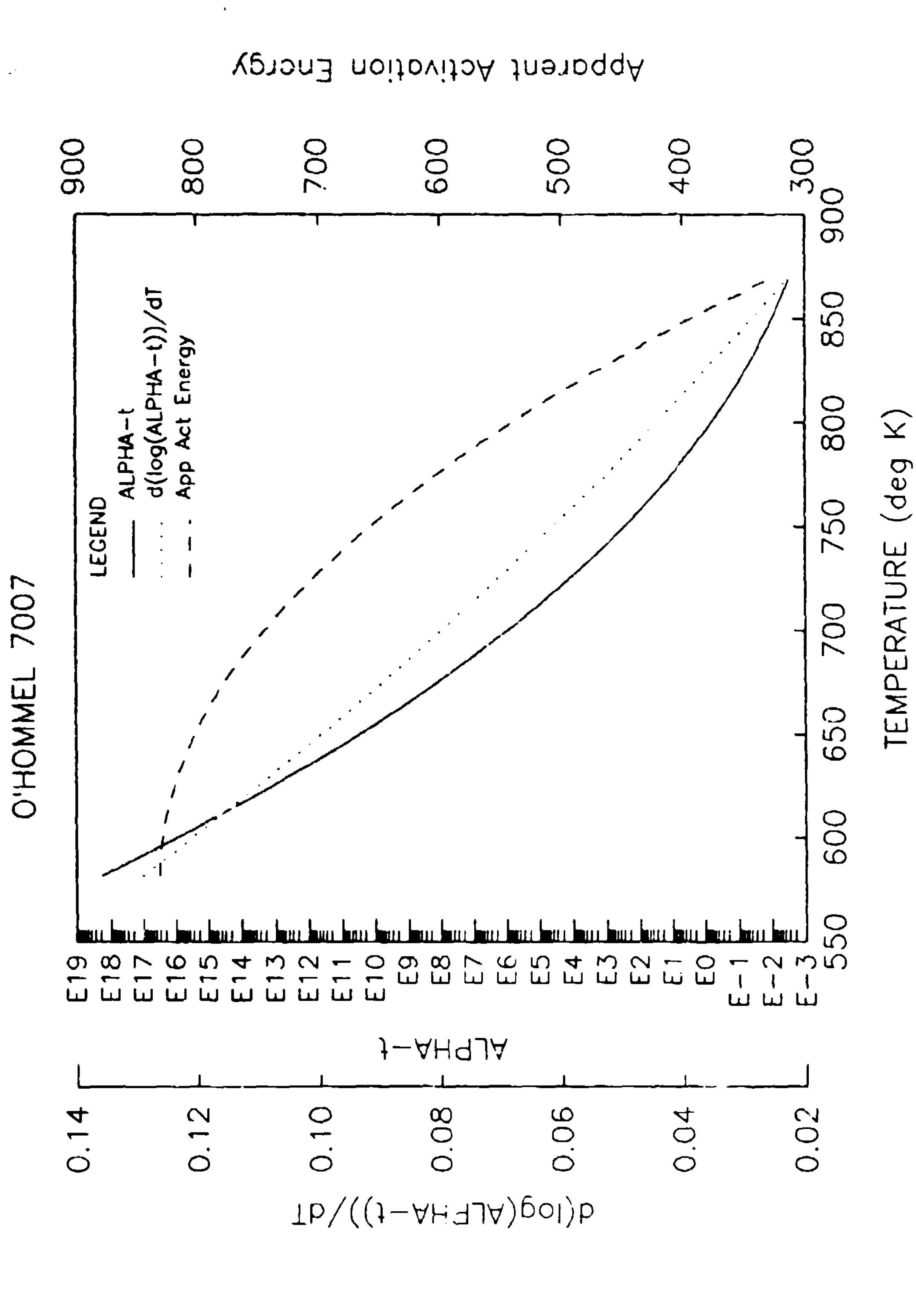

O'HOMMEL 7007
FREQUENCY (Hz)
E1
E2
E3
E4
550
600
650
700
750
800
850
900
TEMPERATURE (deg K)
600
700
800
900
1000
1100
TEMPERATURE (deg F)

O'HOMMEL 7007





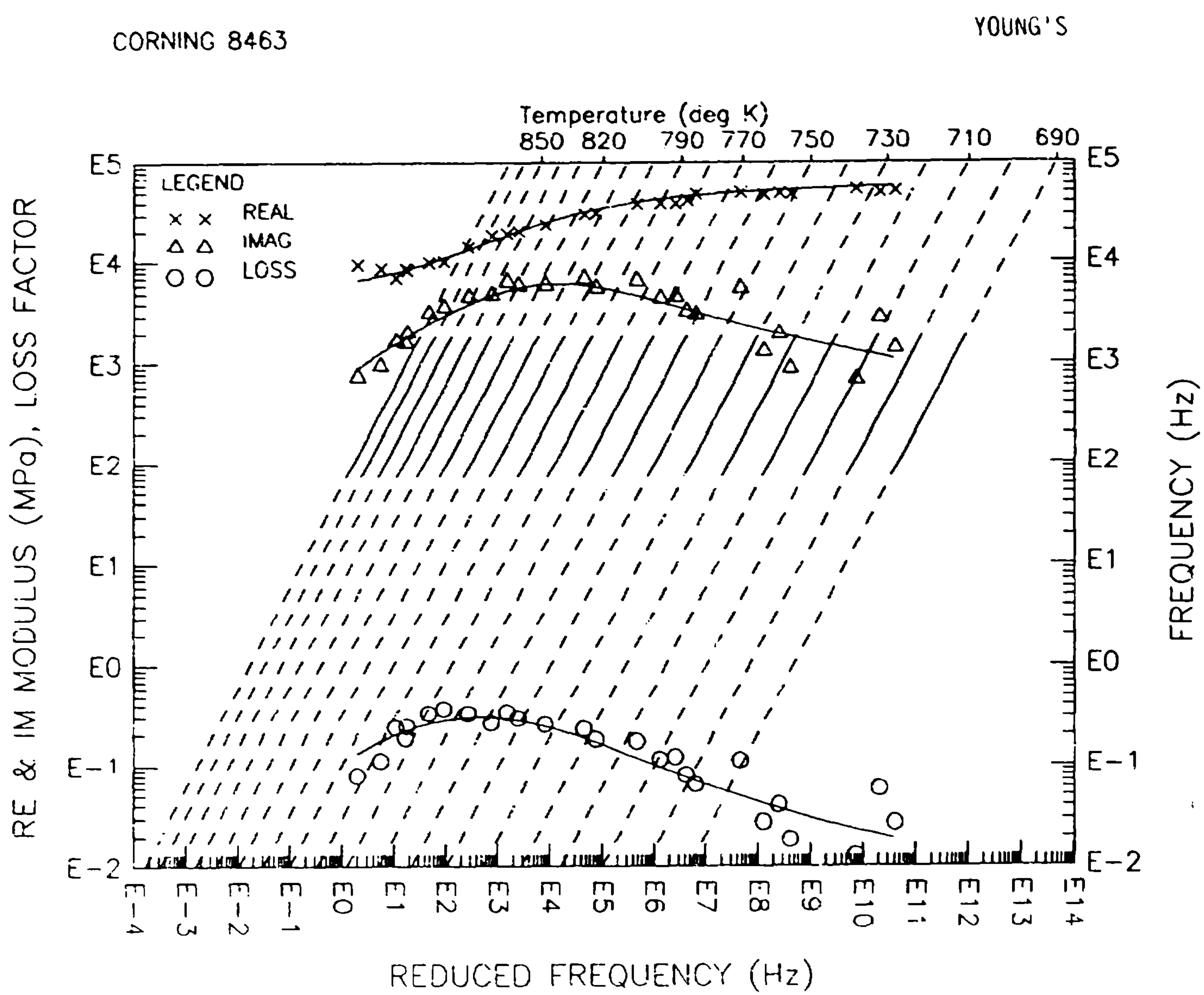
O'HOMMEL 7007
LEGEND
××× REAL
△ △ IMAG
○ ○ LOSS
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR
550
600
650
700
750
800
850
900
E6
E5
E4
E3
E2
E1
E0
E−1
E−2
E−3


O'HOMMEL 7007
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
550
600
650
700
750
800
850
900
ALPHA-t
E-3
E-2
E-1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
E15
E16
E17
E18
E19
d(log(ALPHA-t))/dT
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Apparent Activation Energy
300
400
500
600
700
800
900

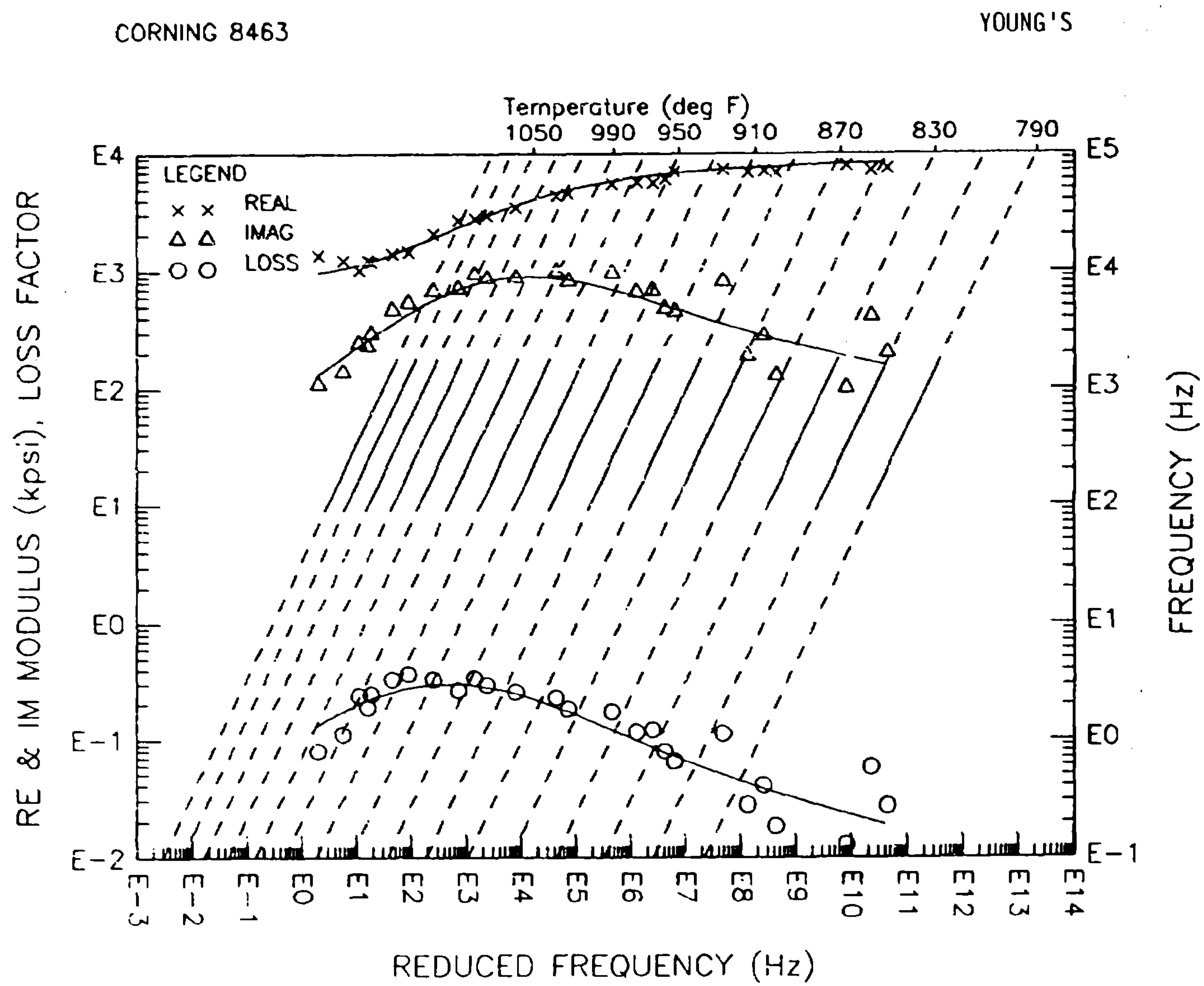
```
         O'HOMMEL 7007                                              YOUNG'S
---------+--------------------------------------------------------+---------+
                              ALFA-T MODEL
NALF  NA     A(1)        A(2)       A(3)        A(4)       A(5)        A(6)
  5    6   795.0       560.0      870.0    0.4583E-010.1296       0.2244E-01
---------+---------+---------+---------+---------+---------+---------+
                              COMPLEX MODULUS MODEL
NVEM  NB     B(1)        B(2)       B(3)        B(4)       B(5)        B(6)
  7    6  0.1652E+060.7563E+05 788.3     0.6166     0.9126       0.5470E-01
---------+---------+---------+---------+---------+---------+---------+
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY
 Temp          Freq       MReal        Eta        MImag
(DEG K)        (HZ)       (MPA)                   (MPA)
 588.8         115.6     0.2550E+060.2400E-02 612.0
 588.8         321.0     0.2510E+060.2500E-02 627.5
 588.8         632.1     0.2530E+060.2800E-02 708.4
 699.9         112.7     0.2420E+060.5300E-02 1283.
 699.9         313.1     0.2380E+060.4400E-02 1047.
 699.9         616.1     0.2400E+060.6900E-02 1656.
 699.9         1022.     0.2420E+060.3900E-02 943.8
 727.6         111.1     0.2350E+060.9500E-02 2233.
 727.6         309.4     0.2330E+060.8100E-02 1887.
 727.6         609.7     0.2350E+060.7000E-02 1645.
 727.6         1012.     0.2370E+060.6300E-02 1493.
 755.4         108.9     0.2260E+060.2240E-01 5062.
 755.4         303.5     0.2240E+060.2520E-01 5645.
 755.4         599.9     0.2280E+060.1430E-01 3260.
 755.4         995.6     0.2300E+060.1270E-01 2921.
 783.2         104.9     0.2100E+060.5480E-010.1151E+05
 783.2         293.4     0.2090E+060.3740E-01 7817.
 783.2         972.2     0.2190E+060.2780E-01 6088.
 811.0         100.0     0.1910E+060.3080E-01 5883.
 811.0         282.5     0.1940E+060.3290E-01 6383.
 811.0         561.2     0.1990E+060.3520E-01 7005.
 811.0         934.7     0.2020E+060.5340E-010.1079E+05
 838.8         98.40     0.1850E+060.8100E-02 1499.
 838.8         276.9     0.1860E+060.1320E-01 2455.
 838.8         544.1     0.1870E+060.1840E-01 3441.
 838.8         902.9     0.1890E+060.2770E-01 5235.
 866.5         97.50     0.1810E+060.3800E-02 687.8
 863.5         273.9     0.1820E+060.4300E-02 782.6
 866.5         537.5     0.1830E+060.6500E-02 1190.
 866.5         892.0     0.1840E+060.9400E-02 1730.
 588.8         1047.     0.2540E+060.2300E-02 584.2
 783.2         583.8     0.2160E+060.3090E-01 6674.
```

CORNING 8463 YOUNG's

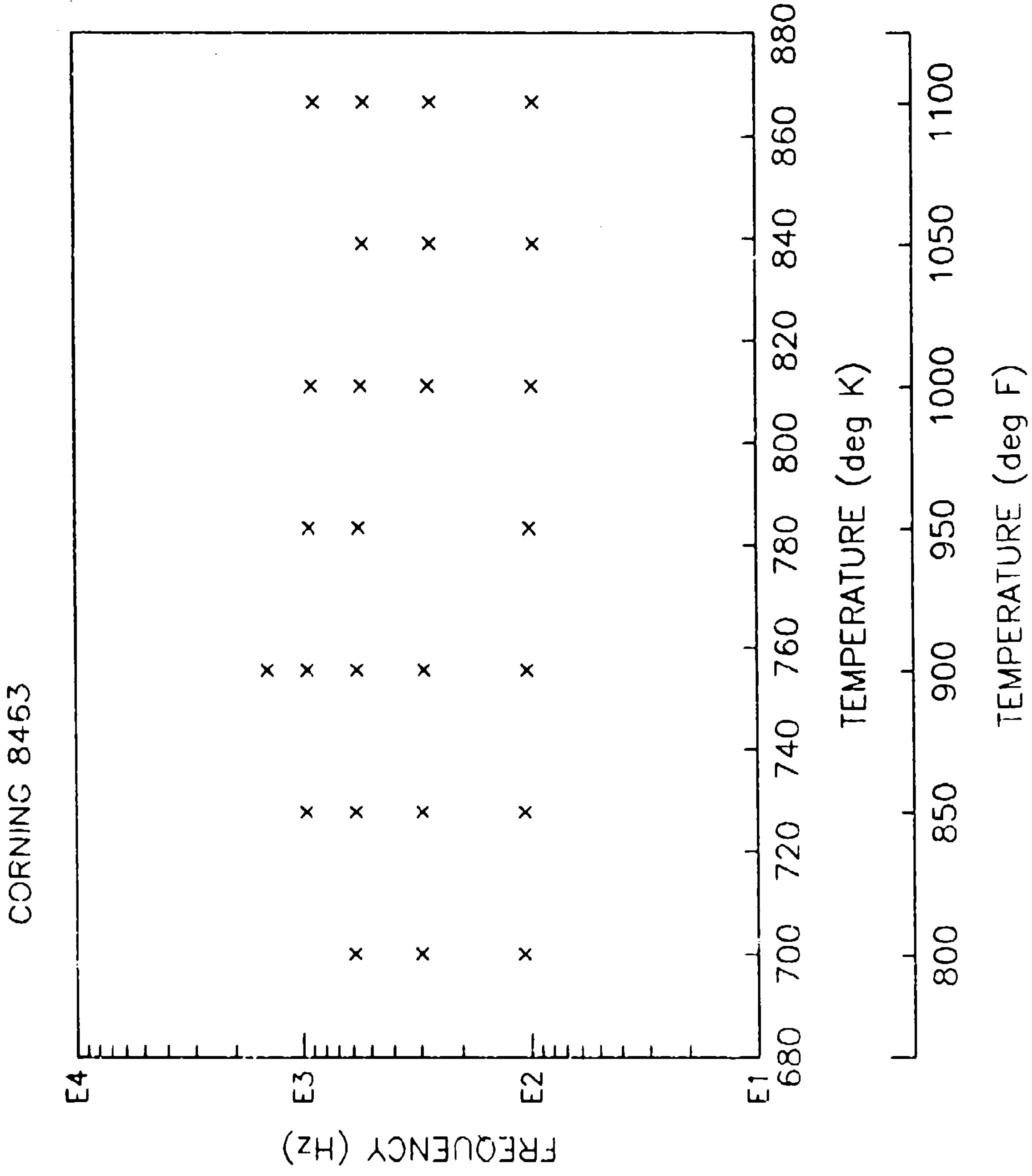
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1898E-01	0.2092	0.2989	0.2092	0.1327
MODULUS	MPA	0.5741E+05	0.2975E+05	0.1457E+05	8239.	6744.
	PSI	0.8326E+07	0.4315E+07	0.2113E+07	0.1195E+07	0.9782E+06
	DEG K		759.0	788.0	817.0	
10.HZ	DEG C		465.9	494.9	523.9	
	DEG F		870.5	922.7	974.9	
	DEG K		775.0	806.0	842.0	
100.HZ	DEG C		481.9	512.9	548.9	
	DEG F		899.3	955.1	1020.	
	DEG K		792.0	828.0	870.0	
1000.HZ	DEG C		498.9	534.9	576.9	
	DEG F		929.9	994.7	1070.	

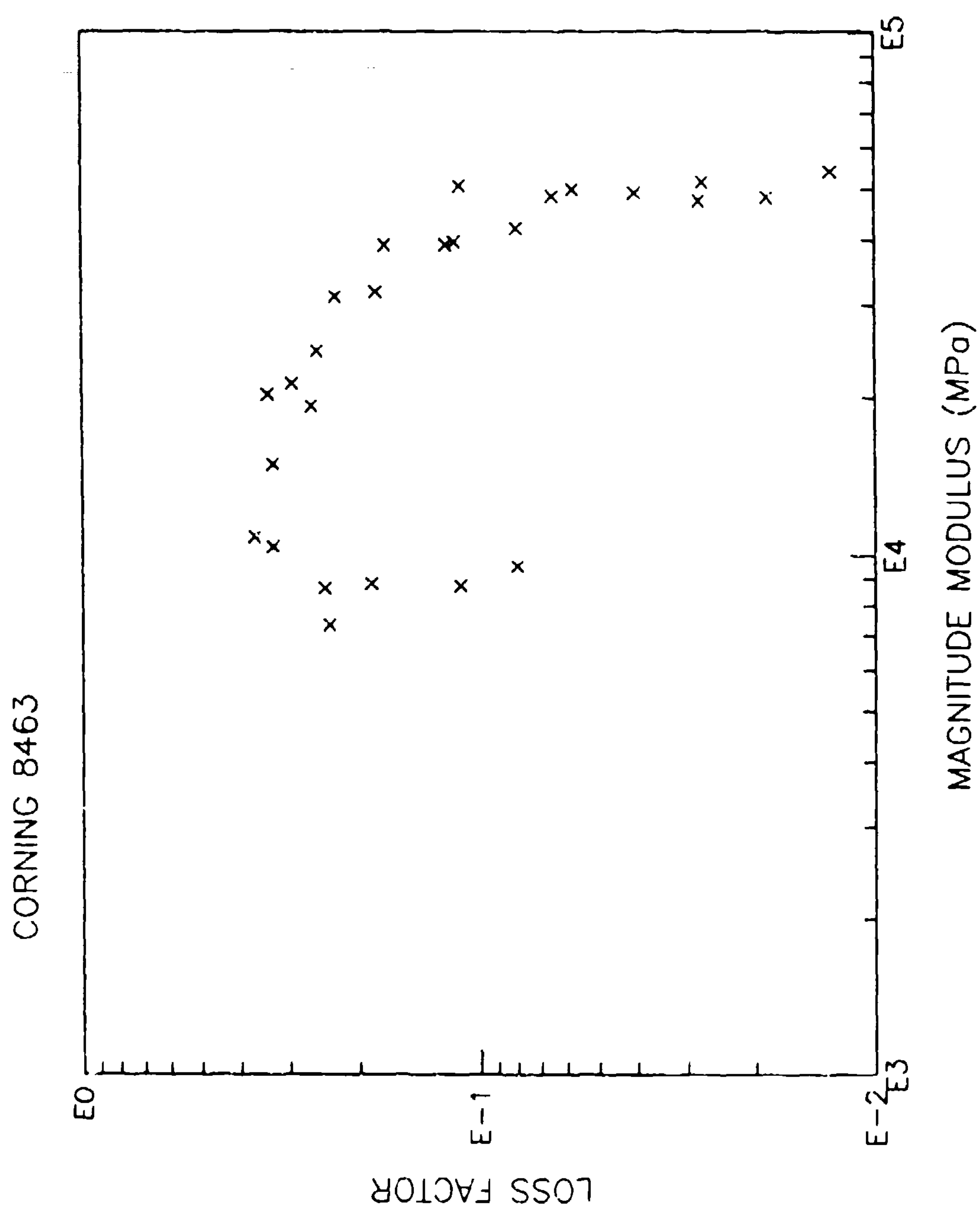


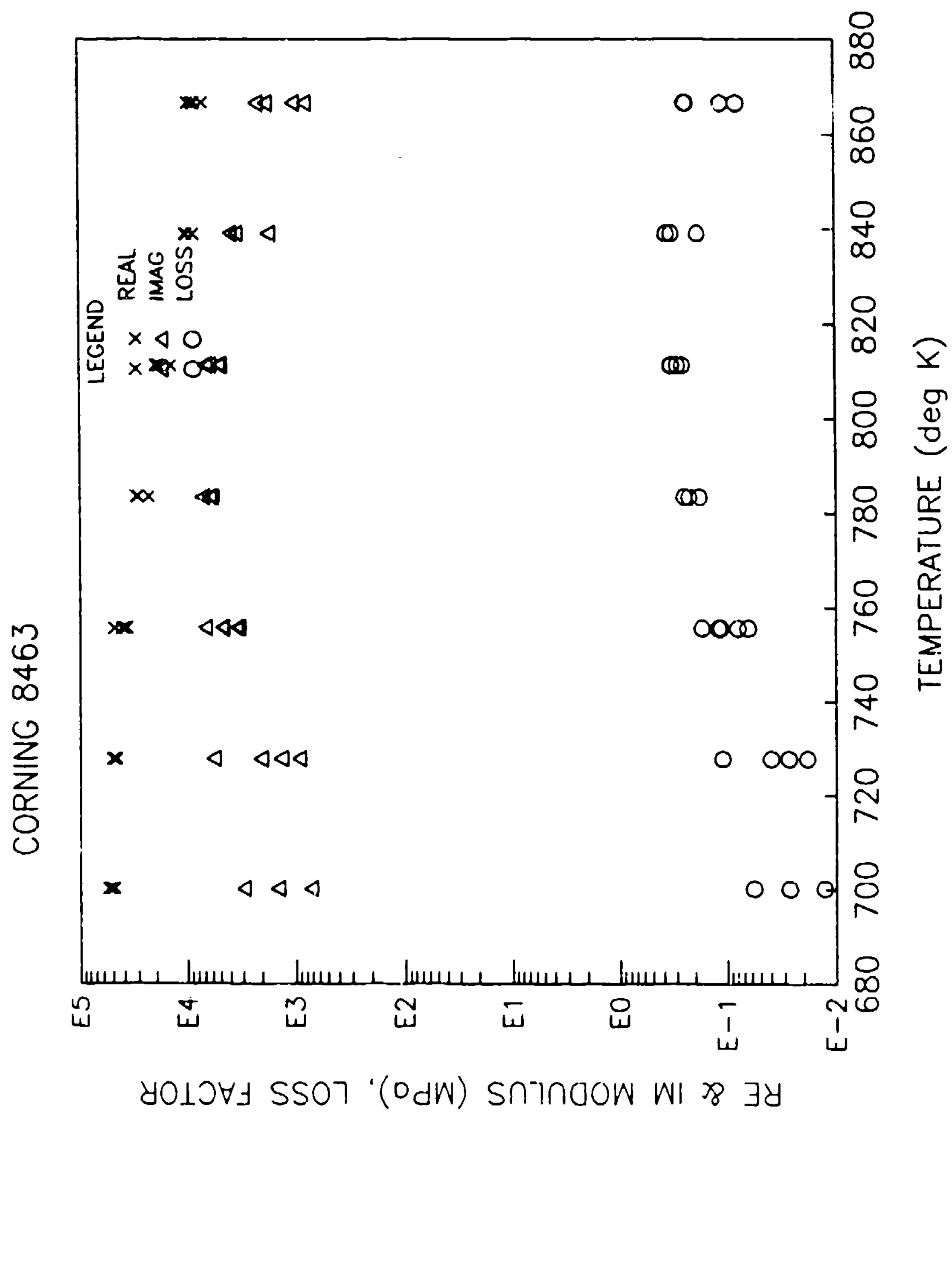
CORNING 8463
YOUNG'S
Temperature (deg K)
850 820 790 770 750 730 710 690
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5
E4
E3
E2
E1
E0
E−1
E−2
FREQUENCY (Hz)
E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14
REDUCED FREQUENCY (Hz)



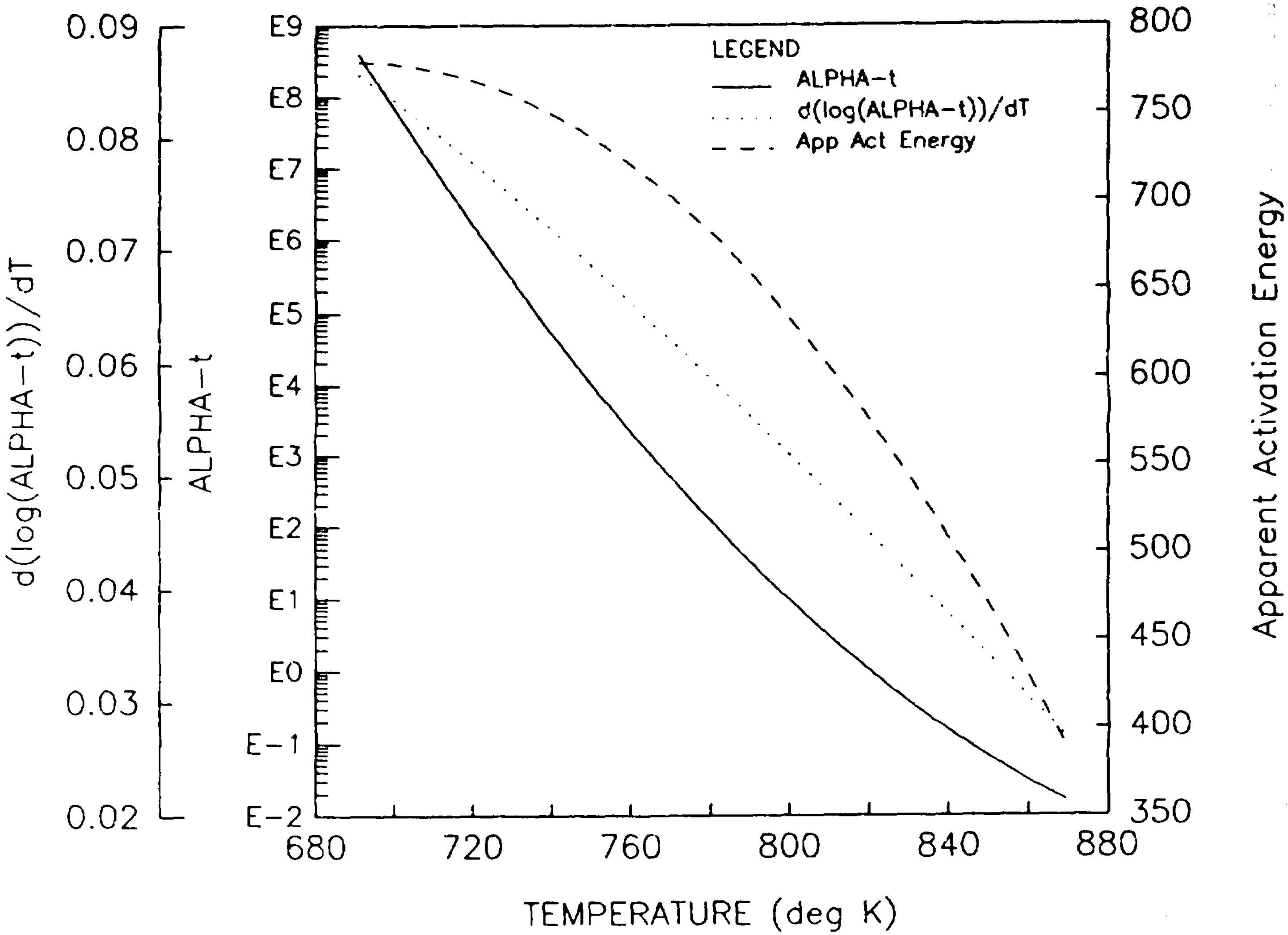
CORNING 8463
YOUNG'S
Temperature (deg F)
1050
990
950
910
870
830
790
LEGEND
REAL
IMAG
LOSS
E4
E3
E2
E1
E0
E-1
E-2
E5
E4
E3
E2
E1
E0
E-1
E-3
E-2
E-1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
RE & IM MODULUS (kpsi), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)


CORNING 8463
E4
E3
E2
E1
FREQUENCY (Hz)
680
700
720
740
760
780
800
820
840
860
880
TEMPERATURE (deg K)
800
850
900
950
1000
1050
1100
TEMPERATURE (deg F)


CORNING 8463
LOSS FACTOR
E0
E-1
E-2
E3
E4
E5
MAGNITUDE MODULUS (MPa)


CORNING 8463
LEGEND
× REAL
△ IMAG
○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5
E4
E3
E2
E1
E0
E−1
E−2
680
700
720
740
760
780
800
820
840
860
880
TEMPERATURE (deg K)

CORNING 8463



CORNING 8463 YOUNG'S

ALPA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	820.0	690.0	870.0	0.4479E-01	0.5583E-01	0.2677E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	5398.	0.5827E+05	0.1266E+05	0.3984	0.6904	0.1172

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

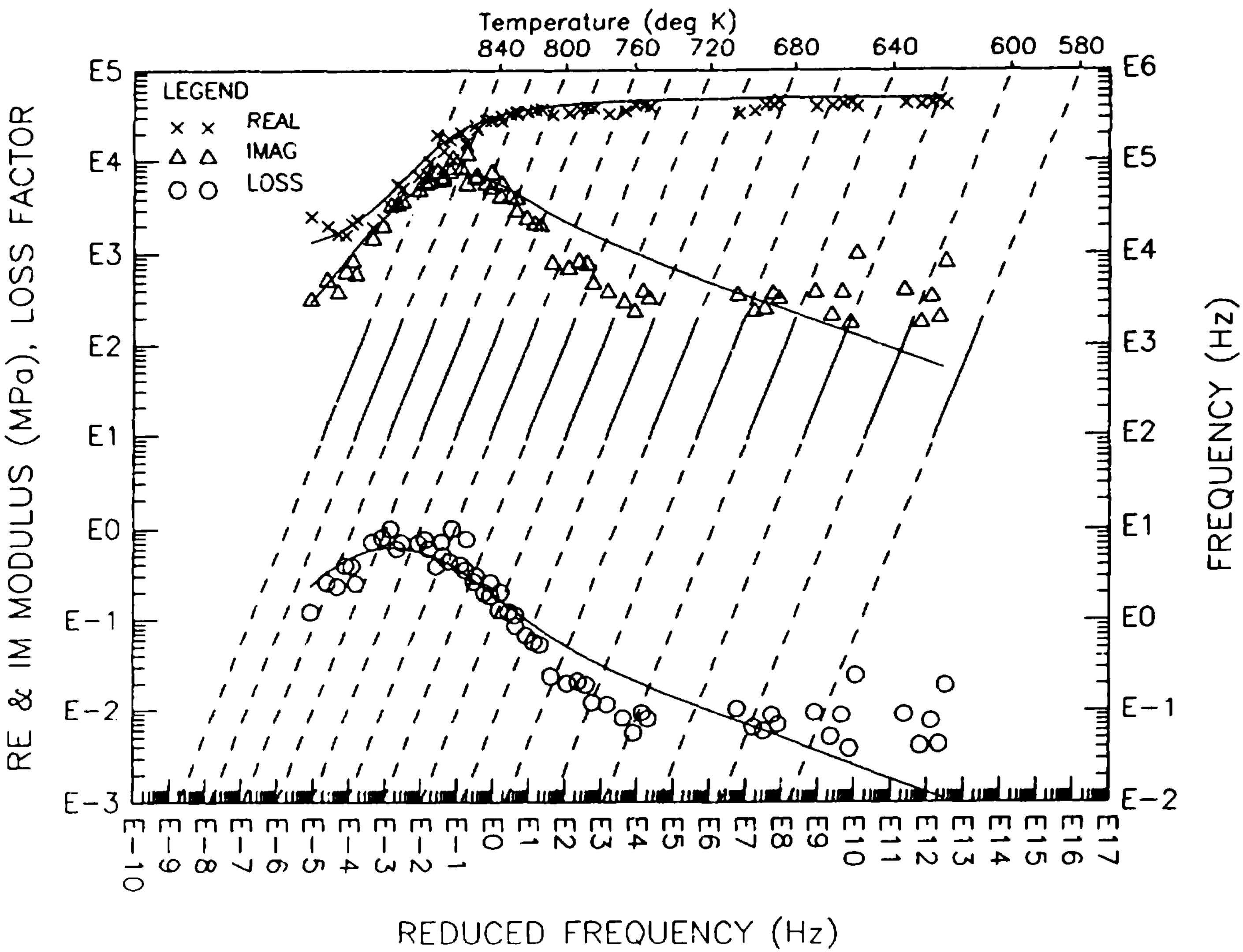
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
866.5	95.40	9420.	0.7980E-01	751.7
866.5	267.2	8610.	0.1117	961.7
866.5	524.3	7090.	0.2384	1690.
866.5	870.7	8330.	0.2454	2044.
838.8	96.10	8600.	0.1875	1613.
811.0	97.60	0.1410E+05	0.3311	4669.
811.0	276.0	0.1850E+05	0.2645	4893.
811.0	543.0	0.1910E+05	0.3392	6479.
811.0	901.4	0.2030E+05	0.2950	5988.
783.2	99.90	0.2360E+05	0.2557	6035.
783.2	557.4	0.3020E+05	0.2294	6928.
783.2	924.9	0.3110E+05	0.1818	5654.
755.4	103.1	0.3820E+05	0.1729	6605.
755.4	289.9	0.3910E+05	0.1154	4512.
755.4	571.1	0.3860E+05	0.1208	4663.
755.4	947.1	0.4170E+05	0.7990E-01	3332.
755.4	1421.	0.4810E+05	0.6480E-01	3117.
727.6	105.6	0.5000E+05	0.1116	5580.
727.6	295.6	0.4730E+05	0.2770E-01	1310.
727.6	581.3	0.4890E+05	0.4030E-01	1971.
727.6	961.8	0.4800E+05	0.1860E-01	892.8
699.9	106.7	0.5360E+05	0.1290E-01	694.0
699.9	298.2	0.4950E+05	0.5780E-01	2861.
699.9	586.2	0.5140E+05	0.2720E-01	1398.
838.8	269.5	9780.	0.3306	3233.
838.8	530.0	0.1010E+05	0.3669	3706.

CORNING 7556 YOUNG'S

		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1080E-02	0.4374	0.6248	0.4374	0.2309
MODULUS	MPA	0.5077E+05	0.1646E+05	5017.	1900.	1313.
	PSI	0.7363E+07	0.2387E+07	0.7276E+06	0.2755E+06	0.1904E+06
	DEG K		766.0	796.0	825.0	
10.HZ	DEG C		472.9	502.9	531.9	
	DEG F		883.1	937.1	989.3	
	DEG K		786.0	818.0	847.0	
100.HZ	DEG C		492.9	524.9	553.9	
	DEG F		919.1	976.7	1029.	
	DEG K		807.0	839.0	869.0	
1000.HZ	DEG C		513.9	545.9	575.9	
	DEG F		956.9	1015.	1069.	

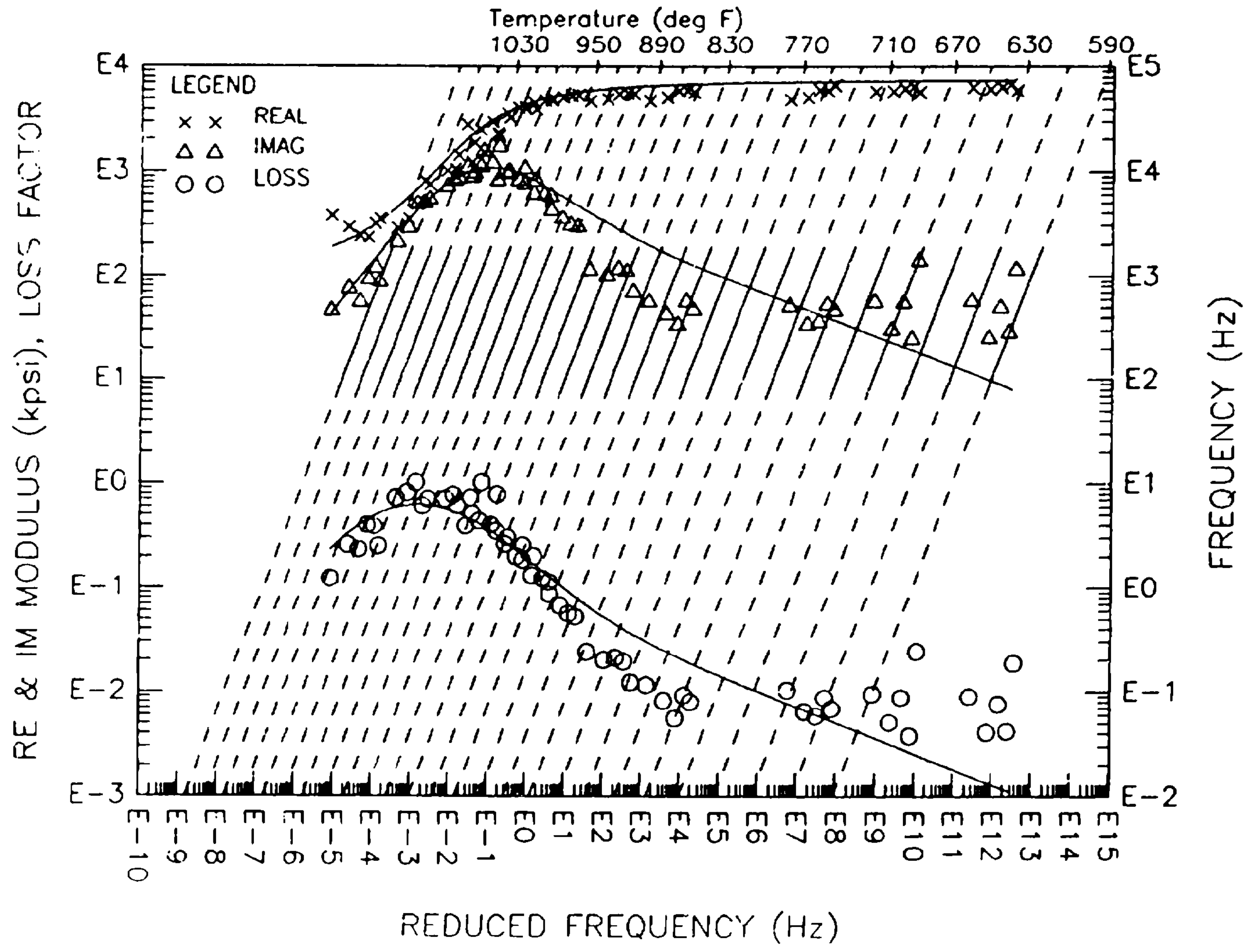
CORNING 7556

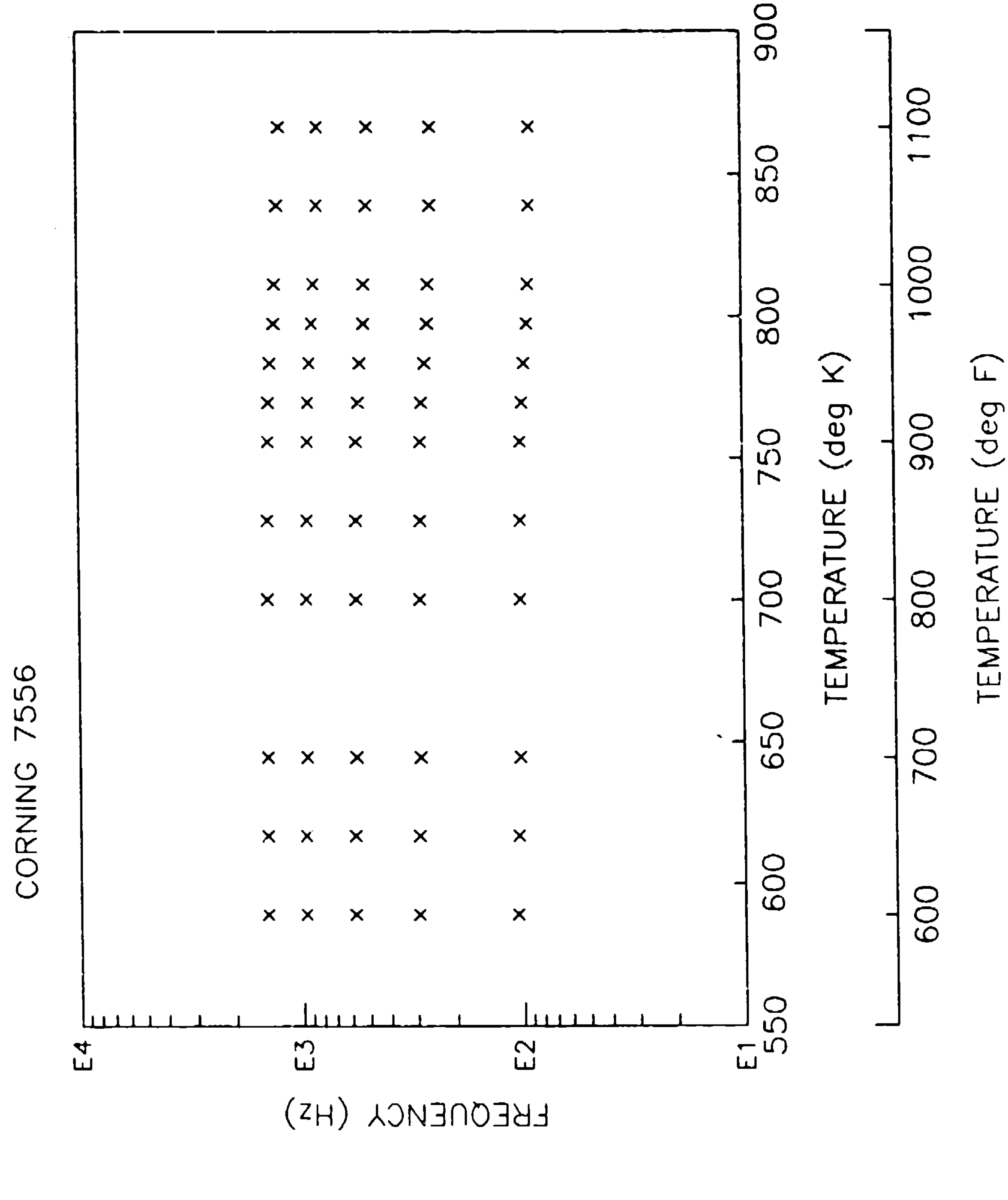
YOUNG'S



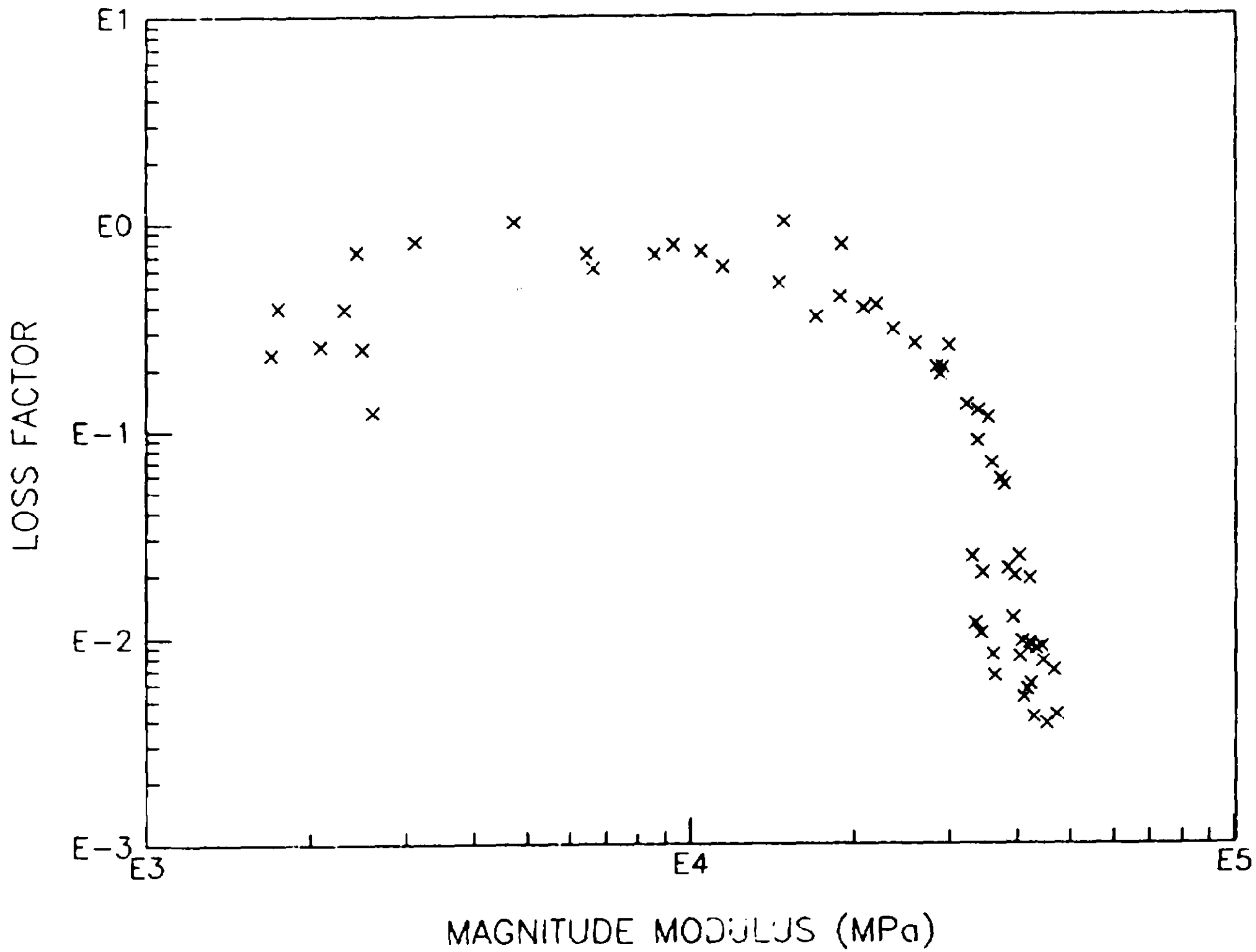
CORNING 7556

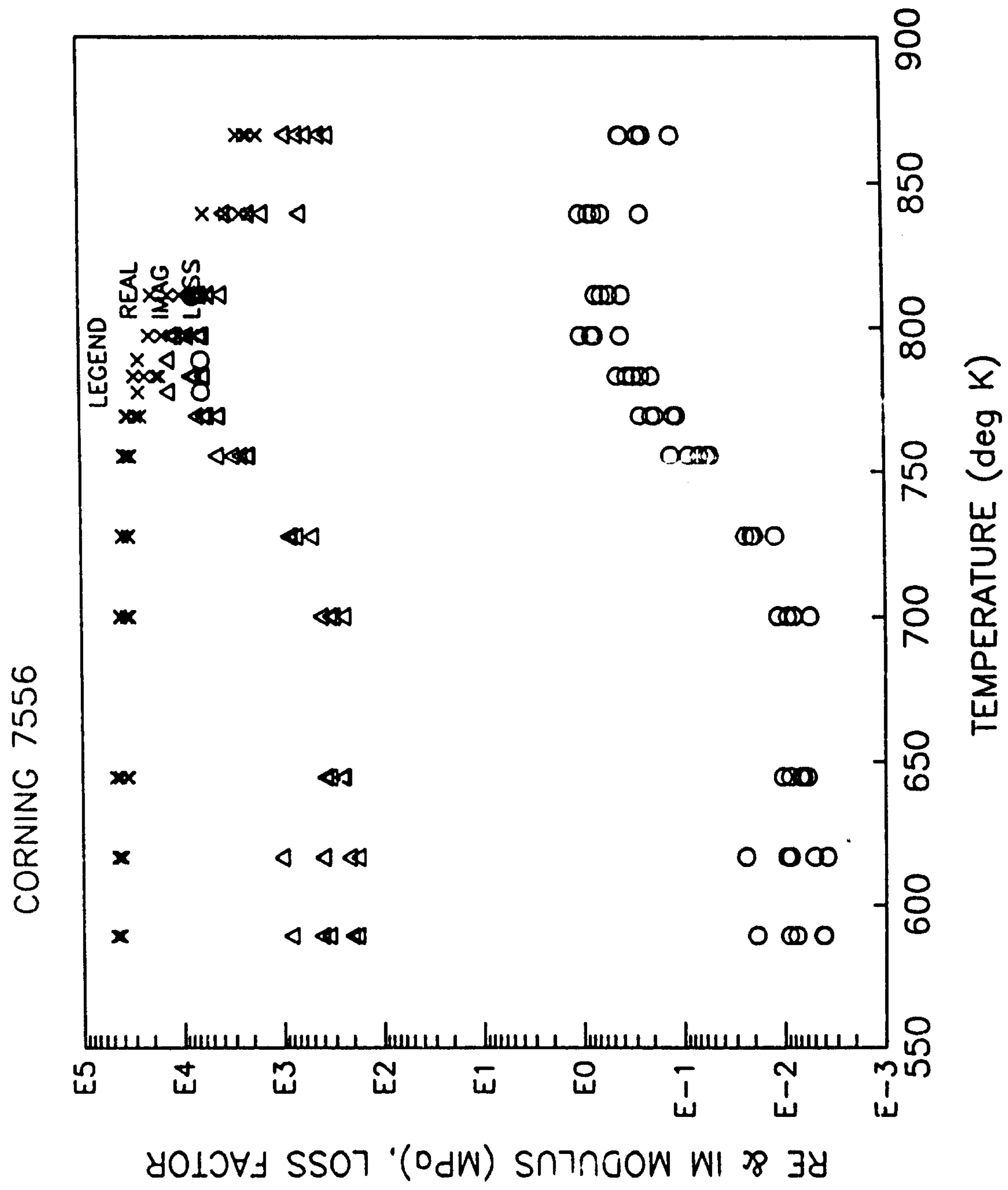
YOUNG'S

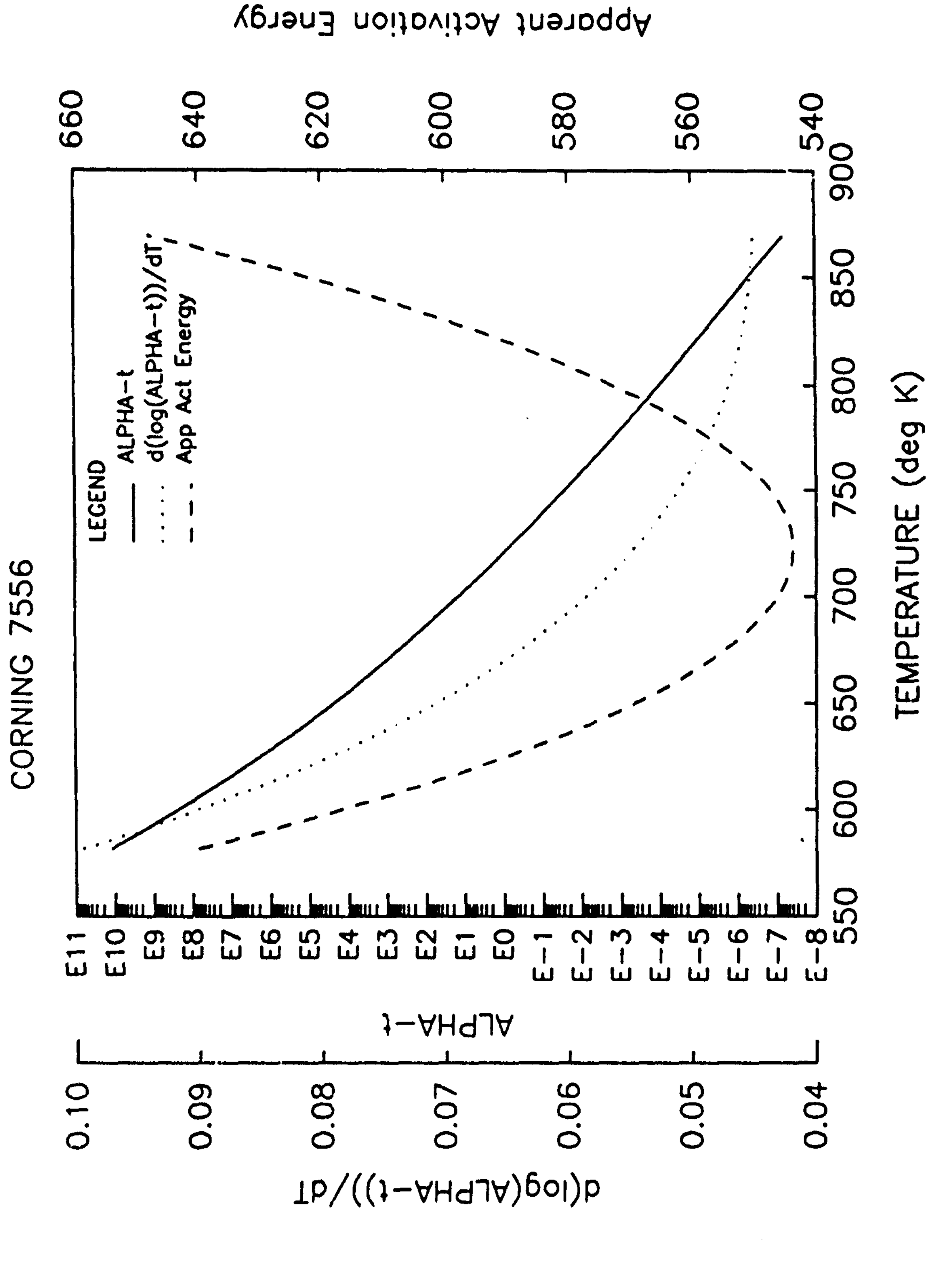



CORNING 7556
FREQUENCY (Hz)
E4
E3
E2
E1
550
600
650
700
750
800
850
900
TEMPERATURE (deg K)
600
700
800
900
1000
1100
TEMPERATURE (deg F)

CORNING 7556




CORNING 7556
LEGEND
REAL
IMAG
LOSS
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR
550
600
650
700
750
800
850
900
E5
E4
E3
E2
E1
E0
E−1
E−2
E−3


CORNING 7556
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
ALPHA-t
d(log(ALPHA-t))/dT
Apparent Activation Energy

CORNING 7556 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	720.0	580.0	870.0	0.5500E-01	0.1000	0.4500E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	1000.	0.5000E+05	0.1000	0.5000	0.5000	0.1500

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
588.8	105.9	0.4410E+05	0.9000E-02	396.9
588.8	295.7	0.4260E+05	0.4100E-02	174.7
588.8	551.9	0.4430E+05	0.7600E-02	336.7
588.8	968.1	0.4700E+05	0.4200E-02	197.4
588.8	1432.	0.4190E+05	0.1890E-01	791.9
616.5	1420.	0.4000E+05	0.2430E-01	972.0
616.5	961.1	0.4500E+05	0.3800E-02	171.0
616.5	577.9	0.4300E+05	0.8800E-02	378.4
616.5	293.6	0.4090E+05	0.5100E-02	208.6
616.5	104.6	0.4050E+05	0.9500E-02	384.8
644.3	102.5	0.3410E+05	0.1040E-01	354.6
644.3	289.1	0.3610E+05	0.6500E-02	234.7
644.3	570.3	0.4200E+05	0.5900E-02	247.8
644.3	949.9	0.4160E+05	0.8800E-02	366.1
644.3	1414.	0.4650E+05	0.6900E-02	320.9
699.9	101.5	0.3330E+05	0.1160E-01	386.3
699.9	286.9	0.3580E+05	0.8200E-02	293.6
699.9	565.2	0.4 50E+05	0.5600E-02	232.4
699.9	943.6	0.4170E+05	0.9300E-02	387.8
699.9	1403.	0.4020E+05	0.8000E-02	321.6
727.6	933.6	0.3930E+05	0.1950E-01	766.4
727.6	562.5	0.3820E+05	0.2120E-01	809.8
727.6	284.6	0.3430E+05	0.2020E-01	692.9
727.6	100.9	0.3280E+05	0.2400E-01	787.2
755.4	100.2	0.3180E+05	0.1308	4159.
755.4	282.9	0.3340E+05	0.8710E-01	2909.
755.4	556.4	0.3560E+05	0.6770E-01	2410.
755.4	924.5	0.3690E+05	0.5690E-01	2100.
755.4	1383.	0.3760E+05	0.5310E-01	1997.
769.3	1370.	0.3490E+05	0.1139	3975.
769.3	913.8	0.3340E+05	0.1233	4118.
769.3	543.2	0.2770E+05	0.2014	5579.
769.3	278.2	0.2520E+05	0.1851	5220.
769.3	98.10	0.2490E+05	0.2628	6544.
783.2	267.8	0.1600E+05	0.3510	5816.
783.2	95.60	0.1720E+05	0.4388	7547.
783.2	534.1	0.2250E+05	0.3043	6847.
783.2	899.2	0 2840E+05	0.2007	5700.
783.2	1344.	0.2880E+05	0.2542	7321.
797.1	1287.	0.1490E+05	0.7827	0.1166E+05

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
797.1	876.4	0.2030E+05	0.4026	8173.
797.1	512.8	0.1040E+05	1.013	0.1054E+05
797.1	260.5	8420.	0.7270	6121.
811.0	91.40	5240.	0.7091	3716.
797.1	92.40	7320.	0.7768	5686.
811.0	258.6	6980.	0.7087	4947.
811.0	510.3	9730.	0.6138	5972.
811.0	853.5	0.1930E+05	0.3893	7513.
811.0	1276.	0.1290E+05	0.5151	6645.
838.8	90.00	2400.	0.2512	602.9
838.8	252.6	1960.	0.7269	1425.
838.8	494.7	2410.	0.8124	1958.
838.8	822.1	3310.	1.012	3350.
838.8	1238.	5620.	0.6077	3415.
866.5	1216.	2140.	0.3884	831.2
866.5	812.4	1610.	0.3968	638.8
727.6	1394.	0.3900E+05	0.1230E-01	479.7
866.5	490.5	1640.	0.2347	384.9
866.5	250.8	2010.	0.2578	518.2
866.5	89.50	2570.	0.1227	315.3

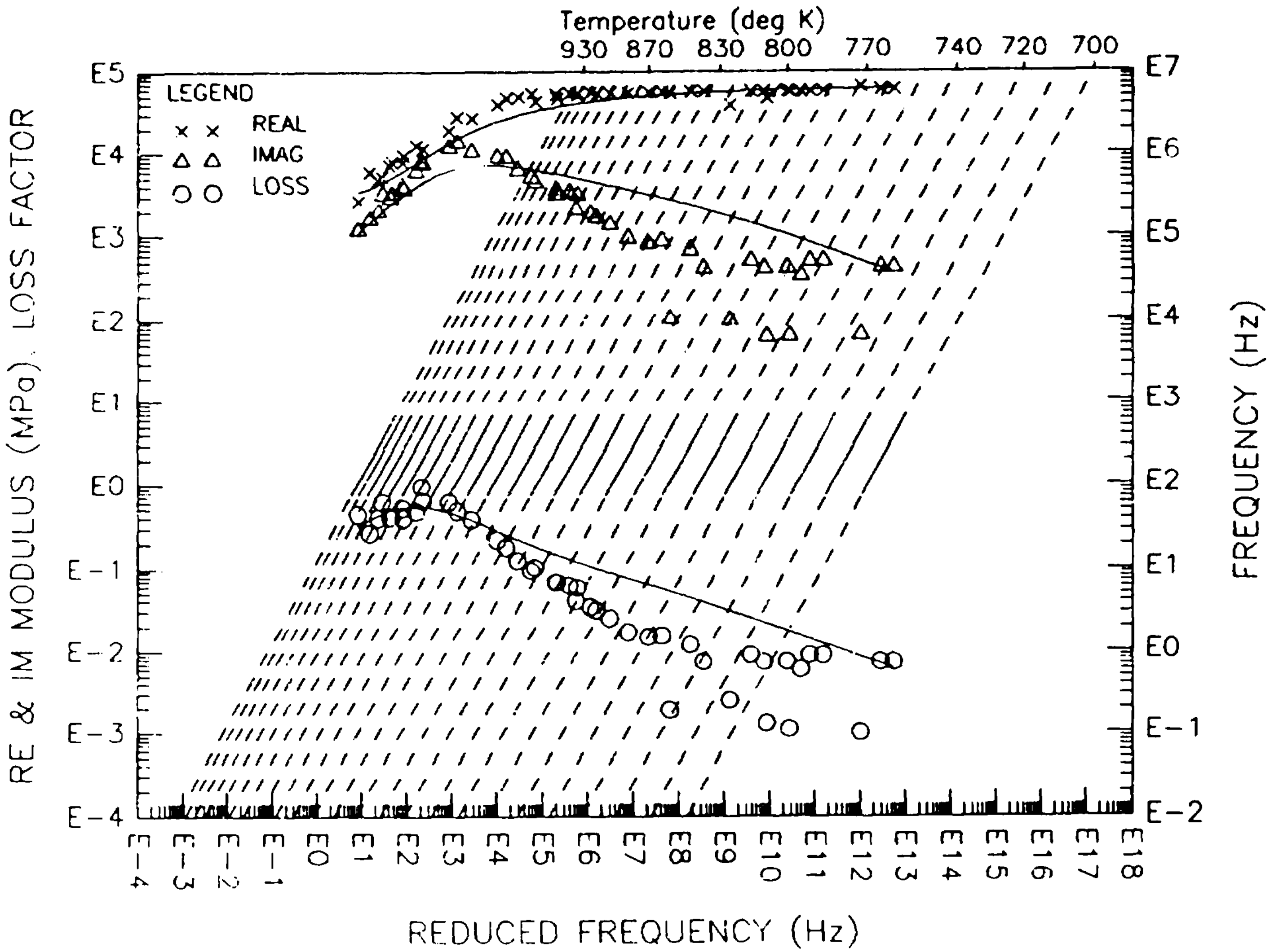
COATING S16-B

YOUNG'S

		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.6179E-02	0.3768	0.5384	0.3768	0.3186
MODULUS	MPA	0.6131E+05	0.1905E+05	7510.	3841.	3468.
	PSI	0.8892E+07	0.2762E+07	0.1089E+07	0.5571E+06	0.5030E+06
10.HZ	DEG K		818.0	847.0	876.0	
	DEG C		524.9	553.9	582.9	
	DEG F		976.7	1029.	1081.	
100.HZ	DEG K		840.0	875.0	916.0	
	DEG C		546.9	581.9	622.9	
	DEG F		1016.	1079.	1153.	
1000.HZ	DEG K		866.0	914.0	930.0	
	DEG C		572.9	620.9	636.9	
	DEG F		1063.	1150.	1178.	

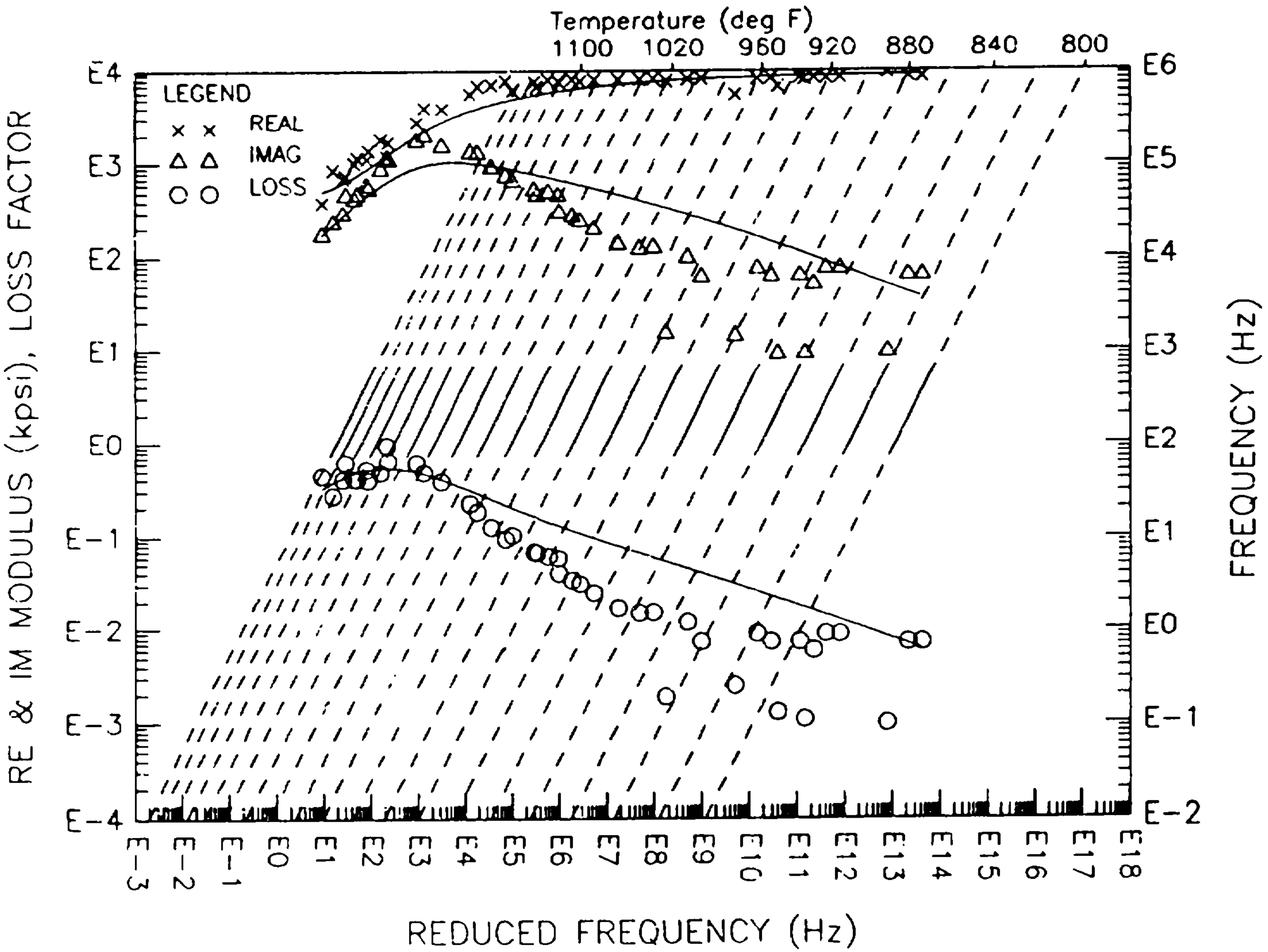
COATING S16-B

YOUNG'S

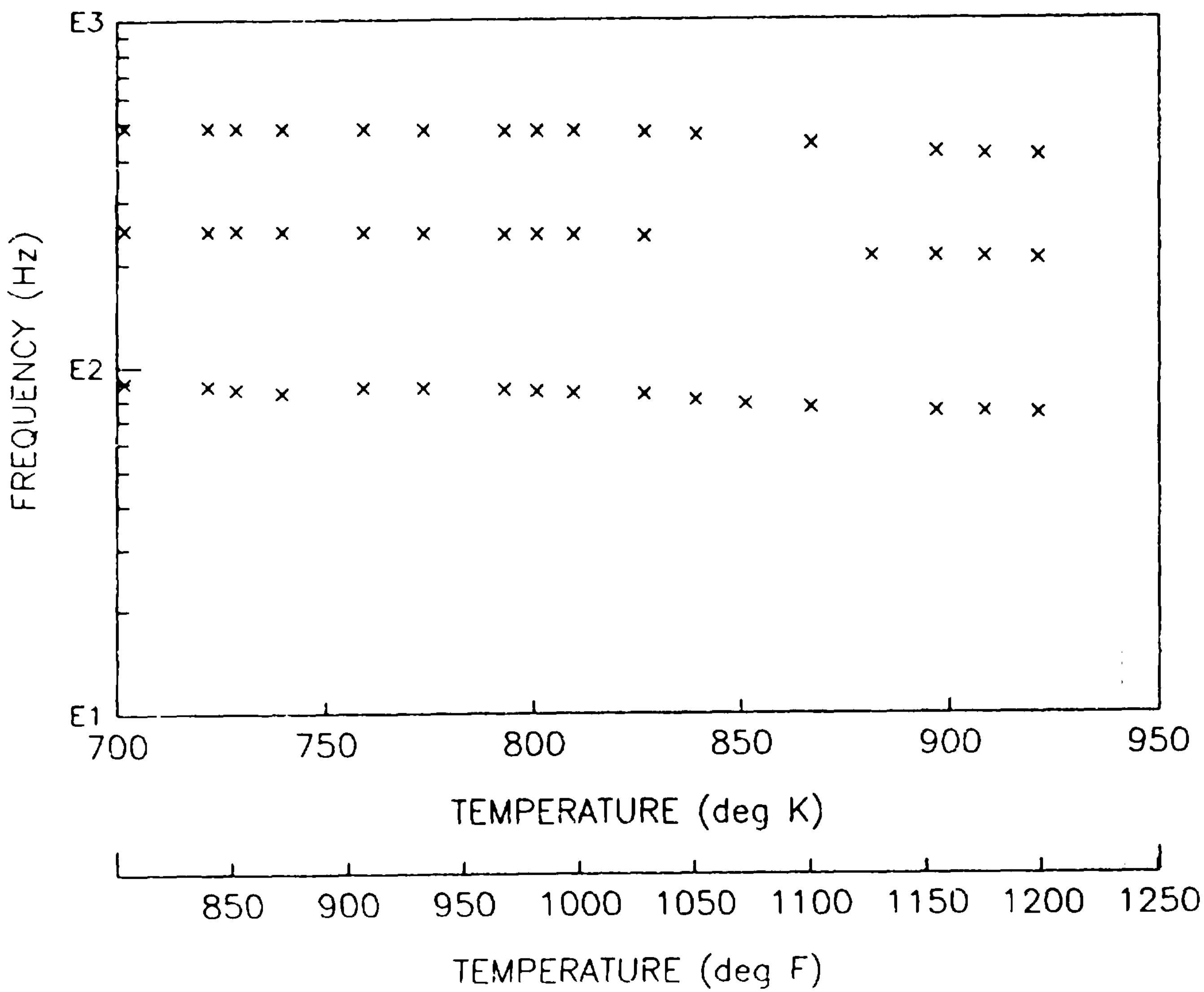


COATING S16-B

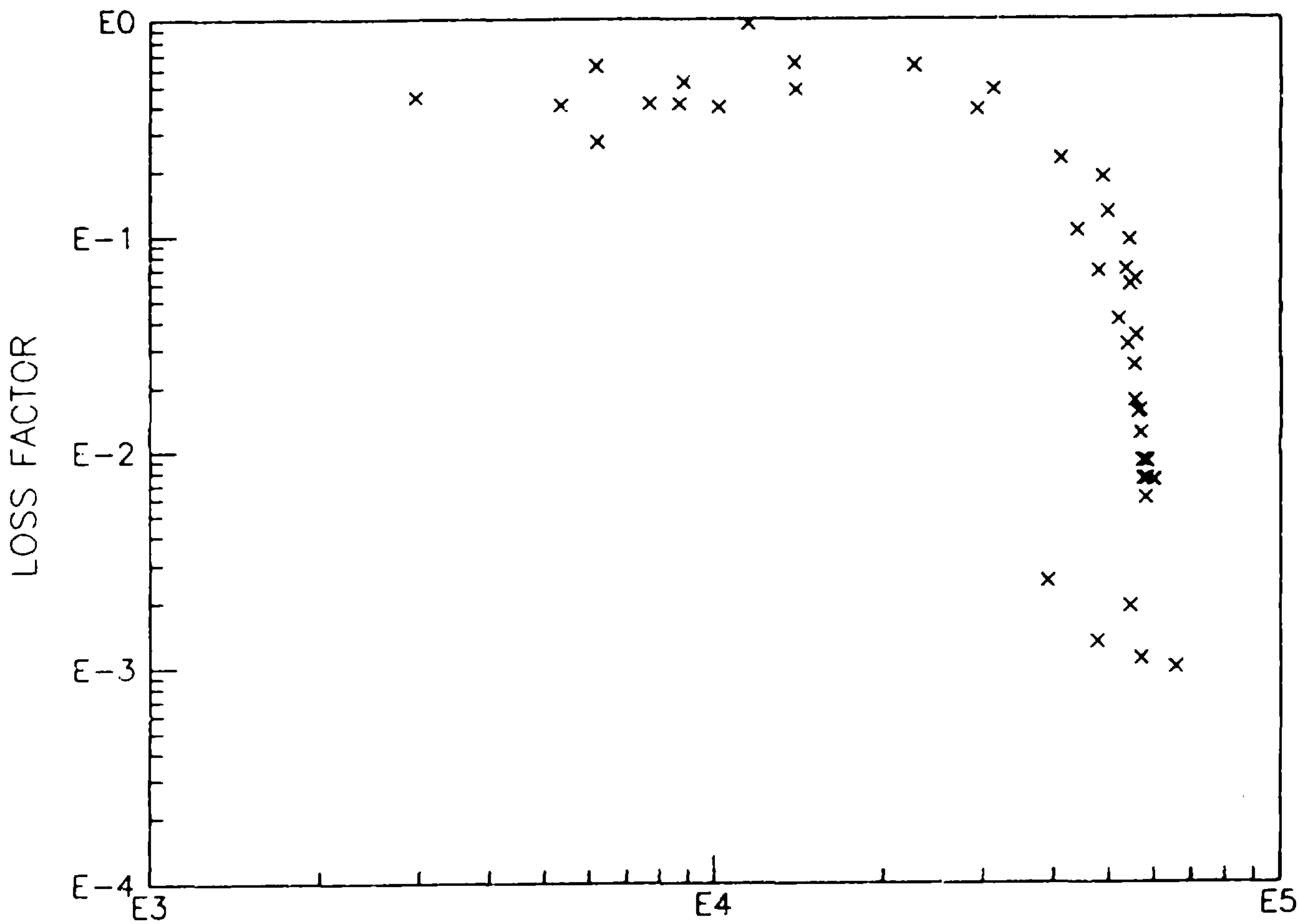
YOUNG'S

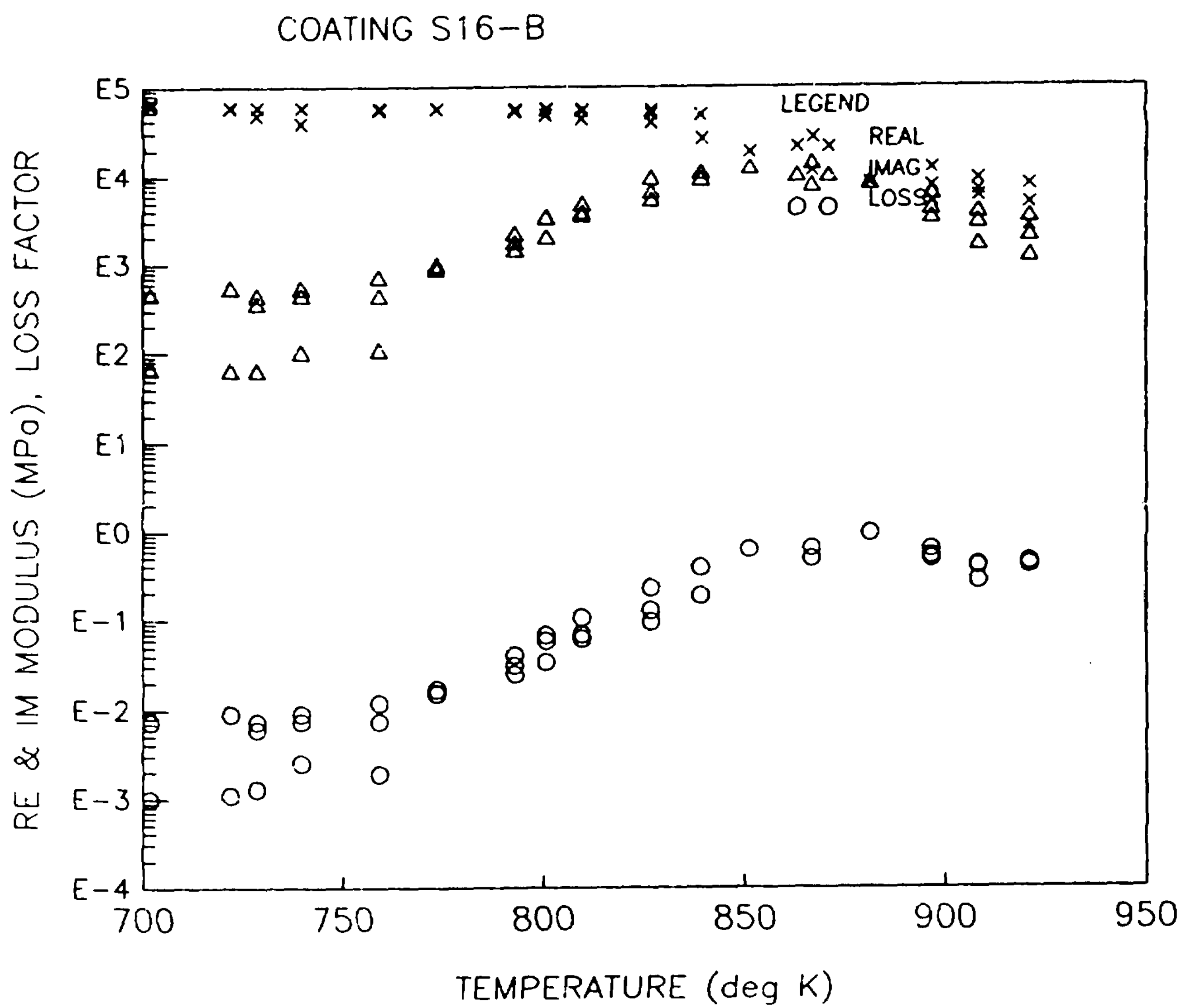


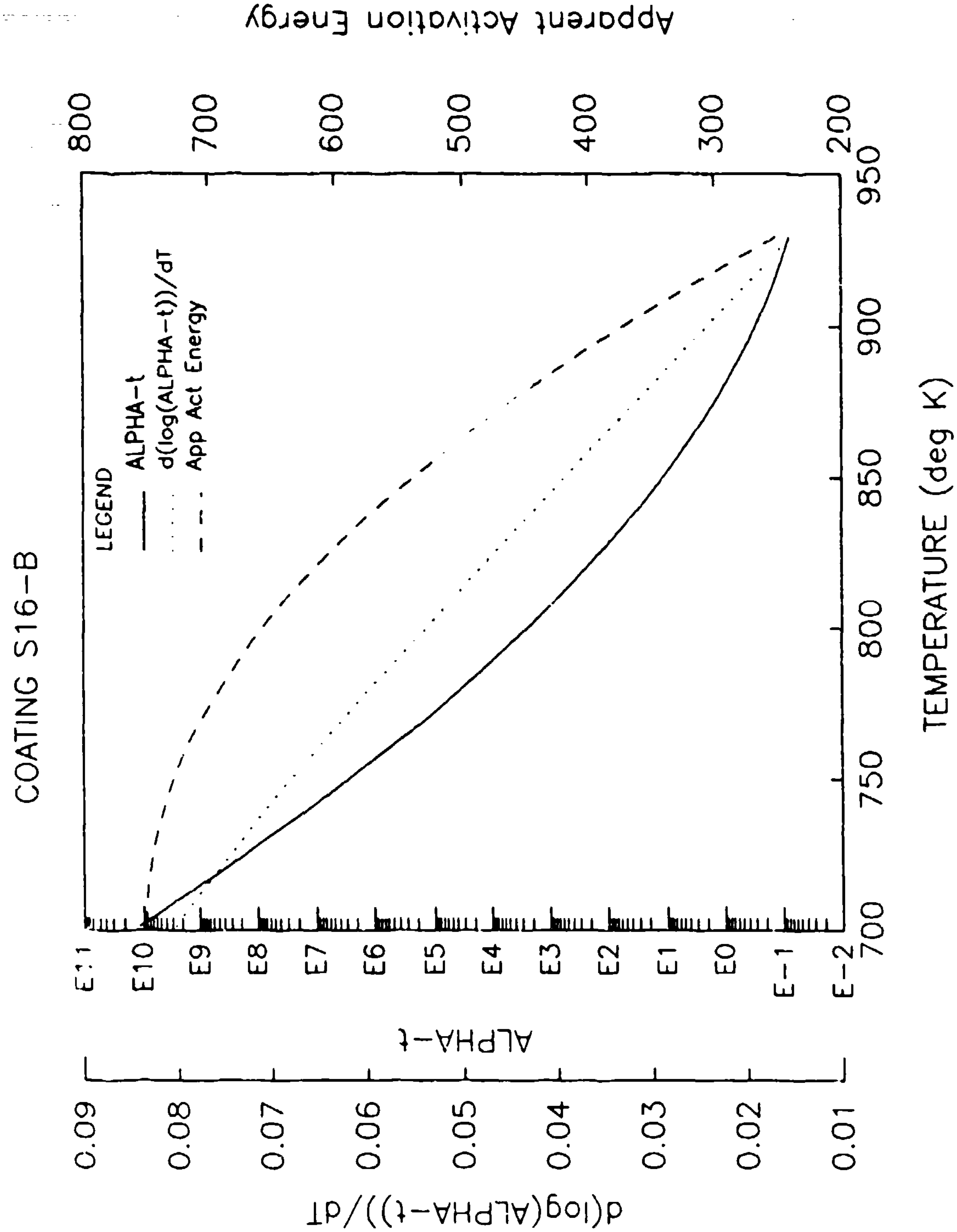
COATING S16-B



COATING S16-B




COATING S16-B
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
700
750
800
850
900
950
TEMPERATURE (deg K)


COATING S16-B
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
TEMPERATURE (deg K)
700
750
800
850
900
950
Apparent Activation Energy
200
300
400
500
600
700
800
ALPHA-t
E-2
E-1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
d(log(ALPHA-t))/dT
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09

COATING S16-B YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	880.0	700.0	930.0	0.3000E-01	0.8050E-01	0.1500E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	2500.	0.6000E+05	3000.	0.6000	1.500	0.2000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

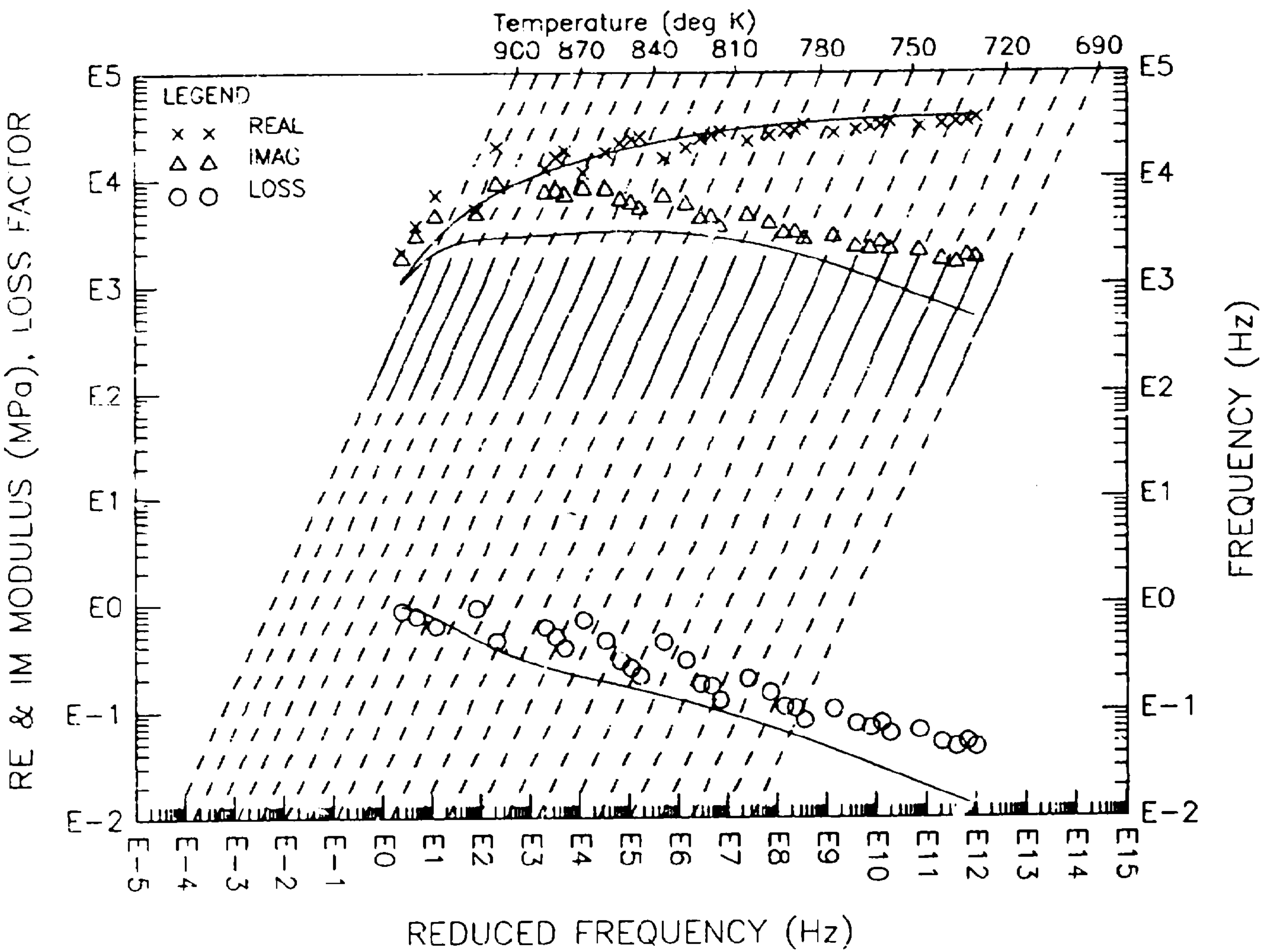
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
701.5	90.00	0.6530E+05	0.1000E-02	65.30
701.5	249.0	0.5990E+05	0.7300E-02	437.3
701.5	488.0	0.5970E+05	0.7300E-02	435.8
721.5	88.00	0.5670E+05	0.1100E-02	62.37
721.5	247.0	0.5770E+05	0.9000E-02	519.3
721.5	485.0	0.5830E+05	0.8900E-02	518.9
728.2	86.00	0.4750E+05	0.1300E-02	61.75
728.2	247.0	0.5810E+05	0.7400E-02	429.9
728.2	484.0	0.5790E+05	0.6000E-02	347.4
739.3	84.00	0.3880E+05	0.2500E-02	97.00
739.3	246.0	0.5710E+05	0.9000E-02	513.9
739.3	483.0	0.5770E+05	0.7400E-02	427.0
758.8	87.00	0.5430E+05	0.1900E-02	103.2
758.8	245.0	0.5670E+05	0.1200E-01	680.4
758.8	481.0	0.5720E+05	0.7400E-02	423.3
773.2	87.00	0.5530E+05	0.1710E-01	945.6
773.2	244.0	0.5590E+05	0.1510E-01	844.1
773.2	479.0	0.5640E+05	0.1540E-01	868.6
792.6	86.00	0.5170E+05	0.4080E-01	2109.
792.6	242.0	0.5370E+05	0.3120E-01	1675.
792.6	476.0	0.5510E+05	0.2500E-01	1378.
800.4	85.00	0.4750E+05	0.6790E-01	3225.
800.4	242.0	0.5420E+05	0.5880E-01	3187.
800.4	476.0	0.5560E+05	0.3420E-01	1902.
809.3	84.00	0.4340E+05	0.1051	4561.
809.3	241.0	0.5310E+05	0.6930E-01	3680.
809.3	475.0	0.5530E+05	0.6210E-01	3434.
826.4	83.00	0.3990E+05	0.2261	9021.
826.4	238.0	0.4910E+05	0.1277	6270.
826.4	472.0	0.5380E+05	0.9540E-01	5133.
838.8	80.00	0.2710E+05	0.3862	0.1047E+05
838.8	464.0	0.4770E+05	0.1852	8834.
850.9	78.00	0.1910E+05	0.6207	0.1186E+05
866.5	76.00	0.1160E+05	0.6438	7468.
866.5	438.0	0.2790E+05	0.4848	0.1353E+05
881.0	210.0	8260.	0.9560	7897.
896.4	74.00	5200.	0.6197	3222.
896.4	209.0	7770.	0.5210	4048.
896.4	416.0	0.1250E+05	0.4820	6025.
908.1	74.00	5940.	0.2710	1610.

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
908.1	208.0	7040.	0.4109	2893.
908.1	411.0	9410.	0.3954	3721.
920.9	73.00	2680.	0.4419	1184.
920.9	206.0	4920.	0.4056	1996.
920.9	408.0	7960.	0.4086	3252.

CORNING 8871 YOUNG'S

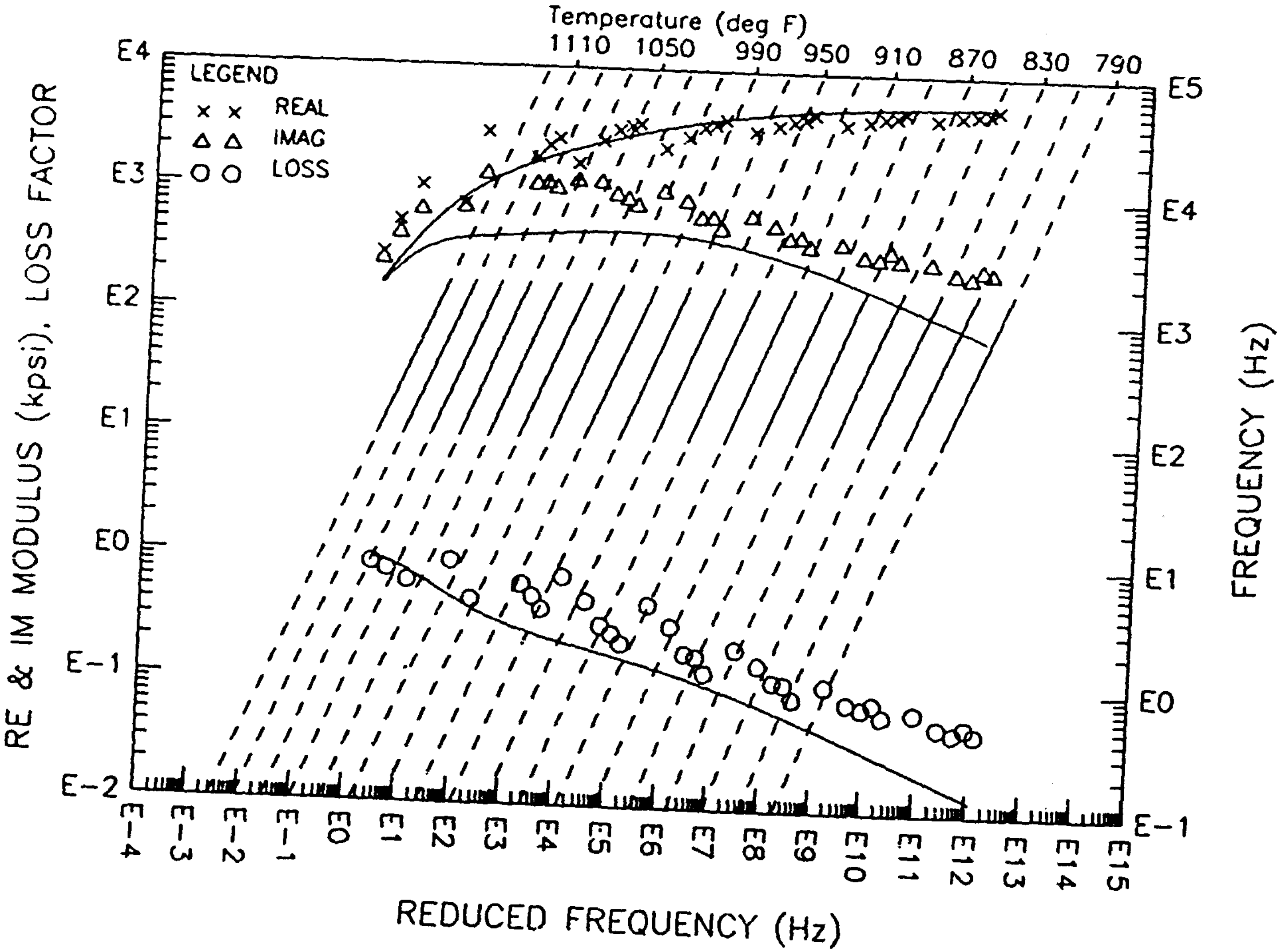
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1282E-01	0.6601	0.9430	0.6601	0.9430
MODULUS	MPA	0.3870E+05	3449.	983.7	467.5	1125.
	PSI	0.5613E+07	0.5002E+06	0.1427E+06	0.6780E+05	0.1631E+06
10.HZ	DEG K		844.0	865.0	882.0	
	DEG C		550.9	571.9	588.9	
	DEG F		1024.	1061.	1092.	
100.HZ	DEG K		864.0	887.0	900.0	
	DEG C		570.9	593.9	606.9	
	DEG F		1060.	1101.	1124.	
1000.HZ	DEG K		886.0	900.0	0.0000E+00	
	DEG C		592.9	606.9	-293.1	
	DEG F		1099.	1124.	-495.7	

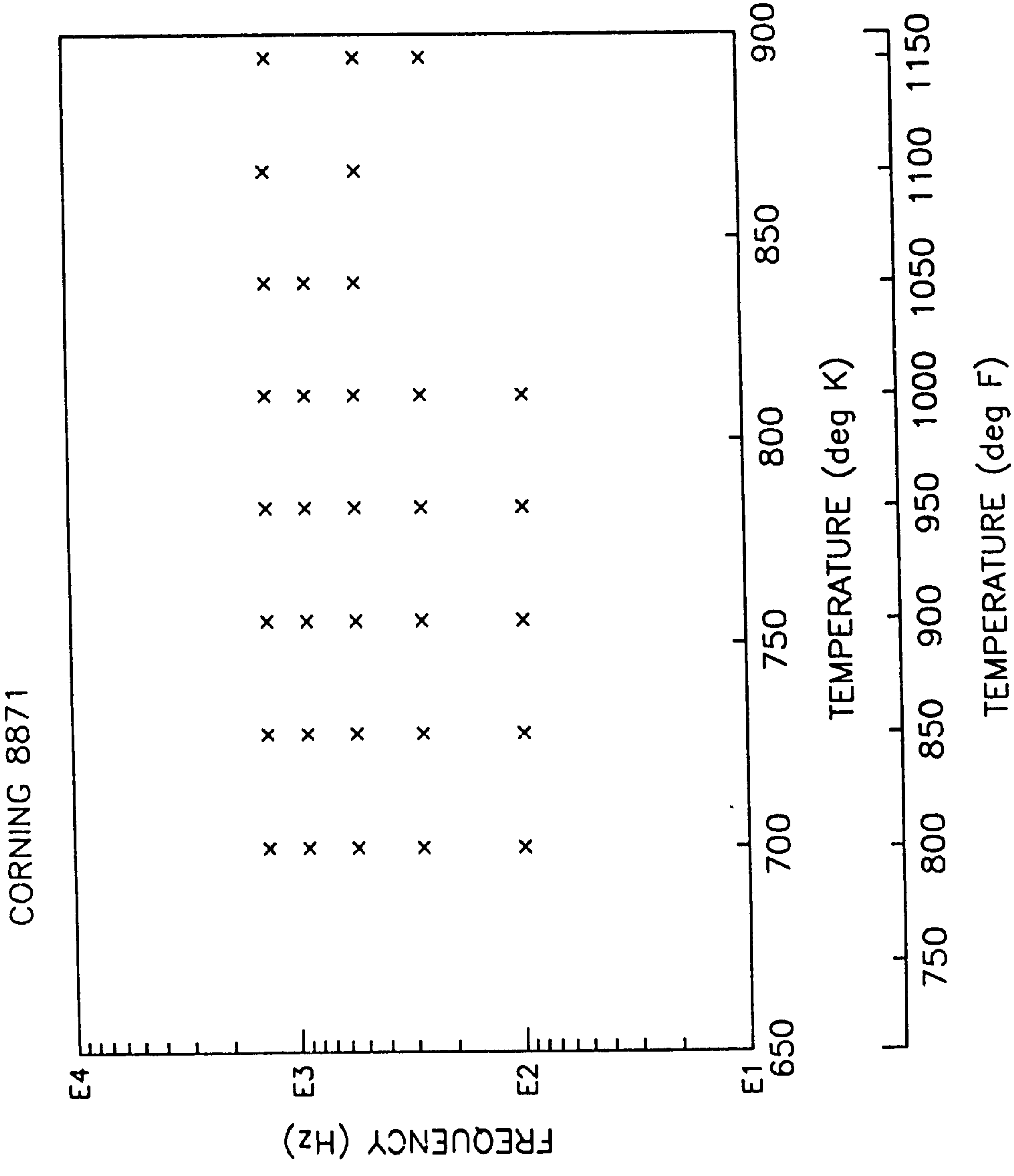
CORNING 8871 YOUNG'S

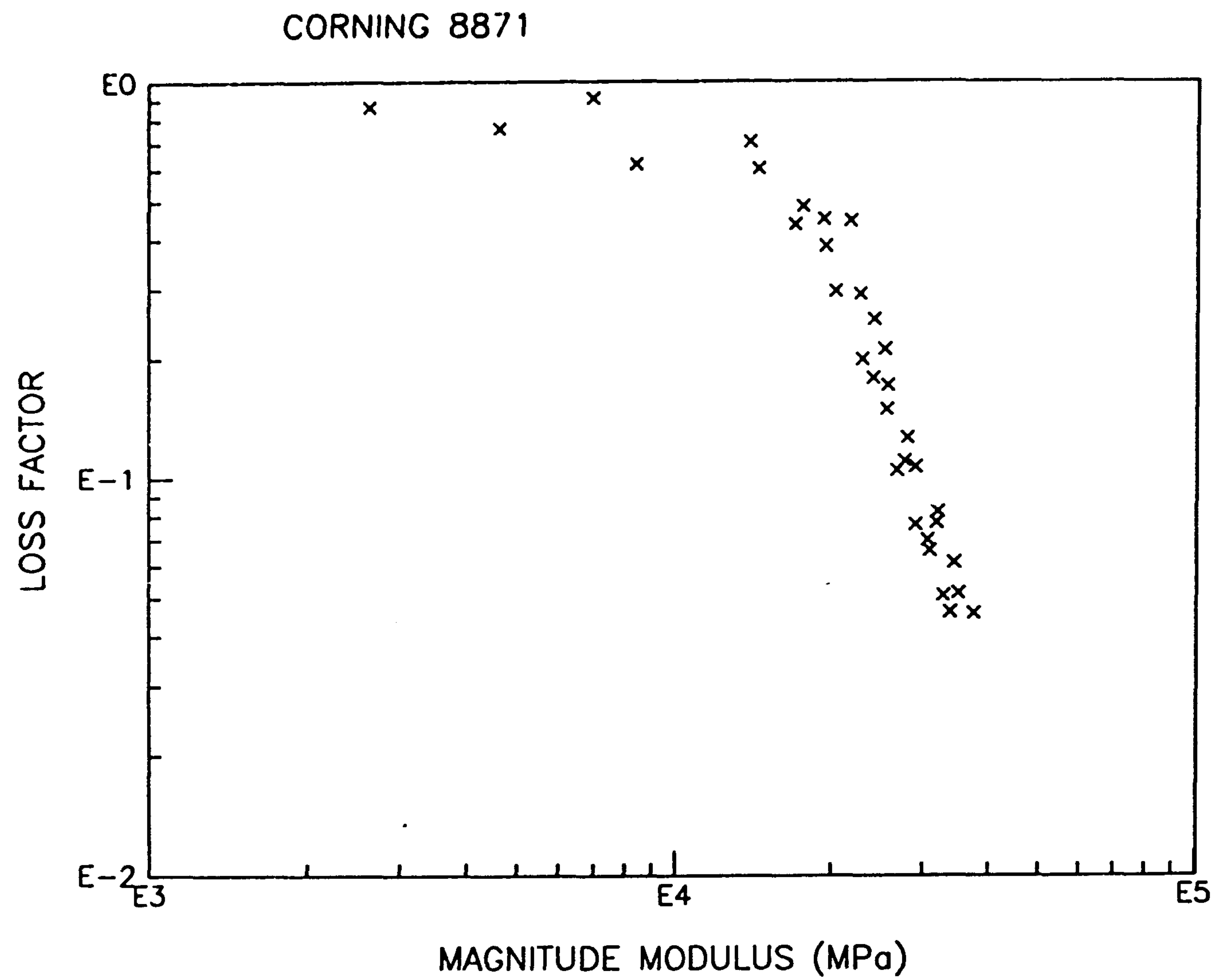


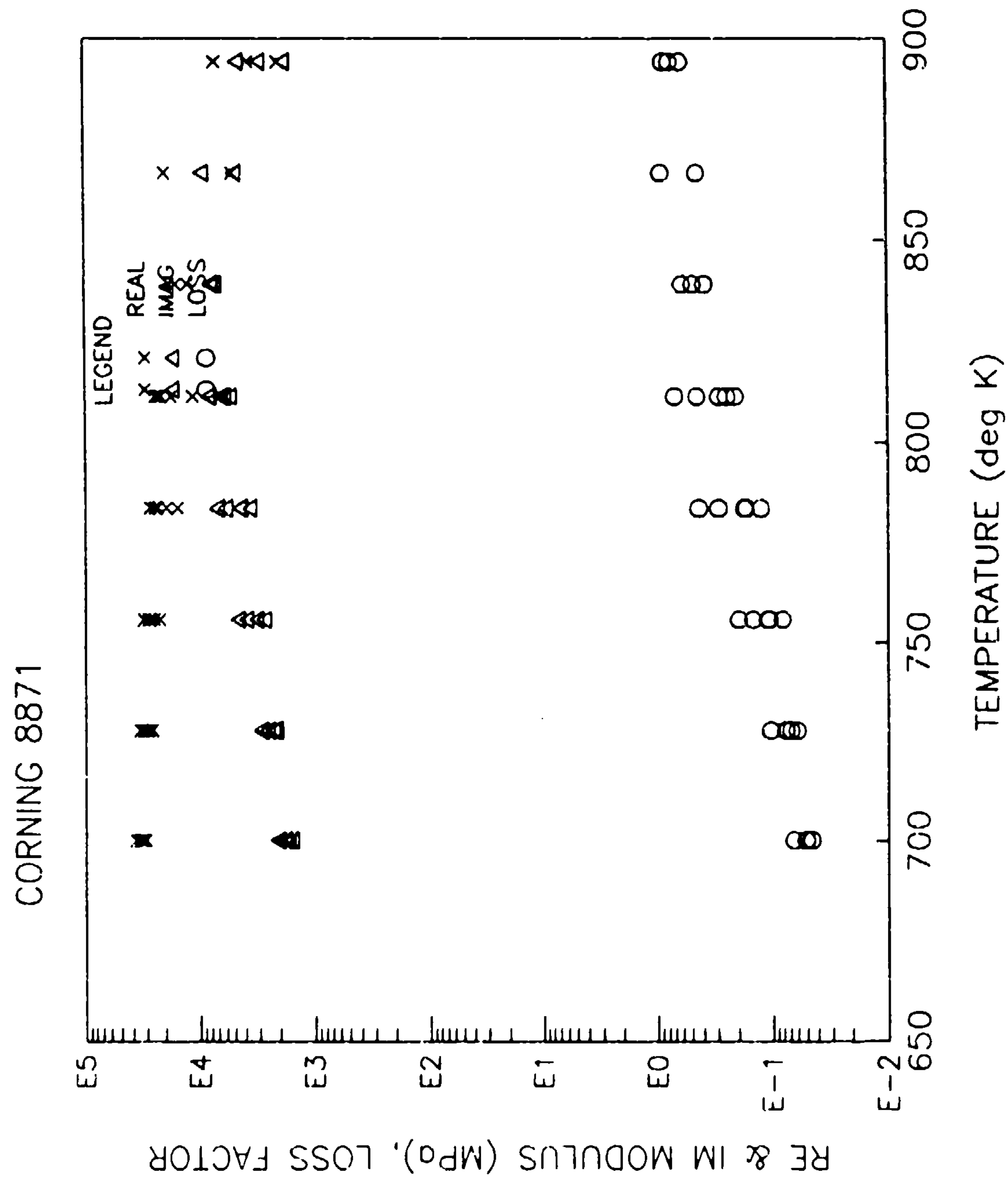
CORNING 8871

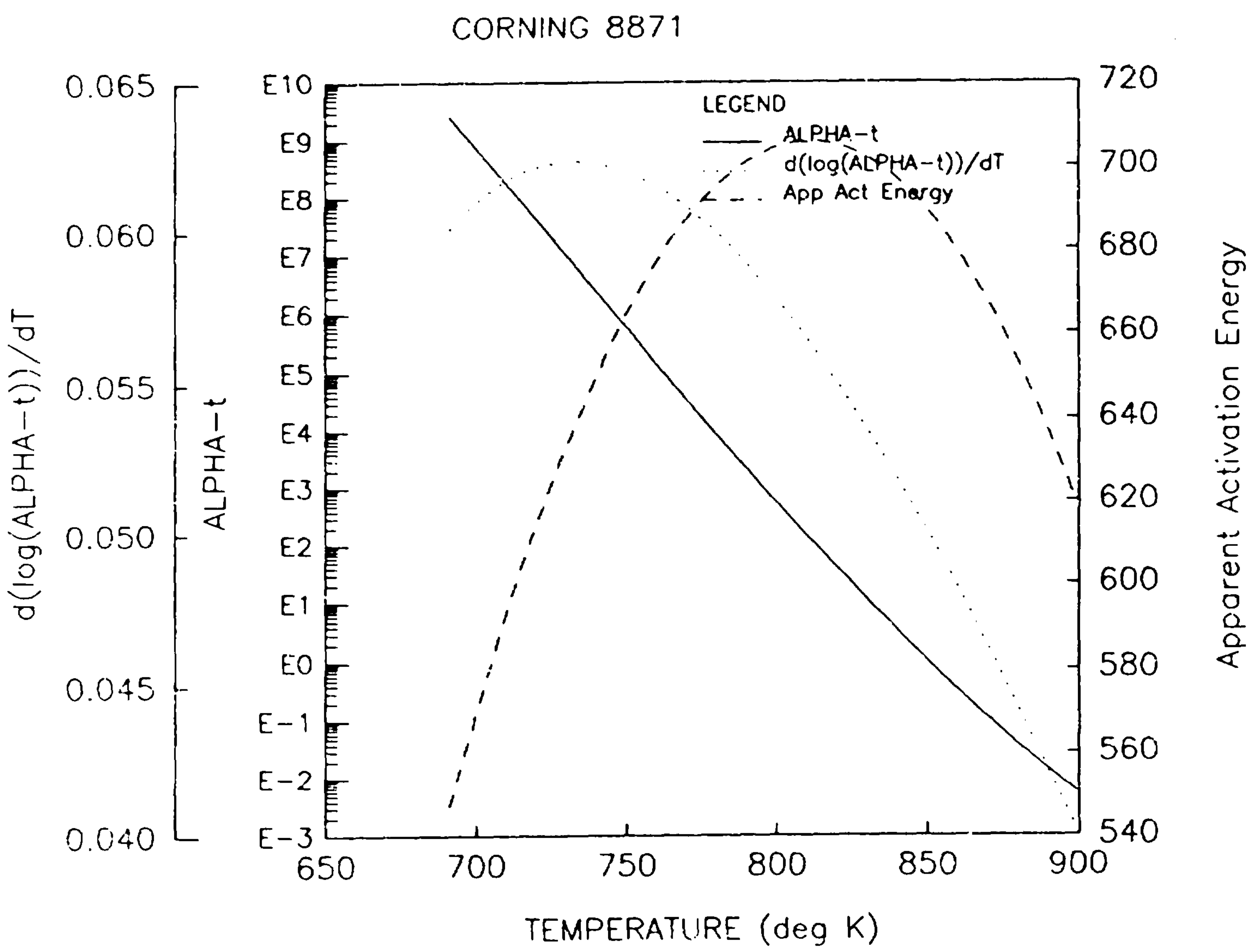
YOUNG'S




CORNING 8871
FREQUENCY (Hz)
E1
E2
E3
E4
650
700
750
800
850
900
TEMPERATURE (deg K)
750
800
850
900
950
1000
1050
1100
1150
TEMPERATURE (deg F)


CORNING 8871
LOSS FACTOR
E0
E−1
E−2
E3
E4
E5
MAGNITUDE MODULUS (MPa)


CORNING 8871
LEGEND
× REAL
△ IMAG
○ LOSS
E5
E4
E3
E2
E1
E0
E−1
E−2
650
700
750
800
850
900
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR


CORNING 8871
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.065
0.060
0.055
0.050
0.045
0.040
ALPHA-t
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
Apparent Activation Energy
720
700
680
660
640
620
600
580
560
540
650
700
750
800
850
900
TEMPERATURE (deg K)

CORNING 8871 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	850.0	690.0	900.0	0.5000E-01	0.6000E-01	0.4000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	300.0	0.4000E+05	150.0	0.7500	4.000	0.2000

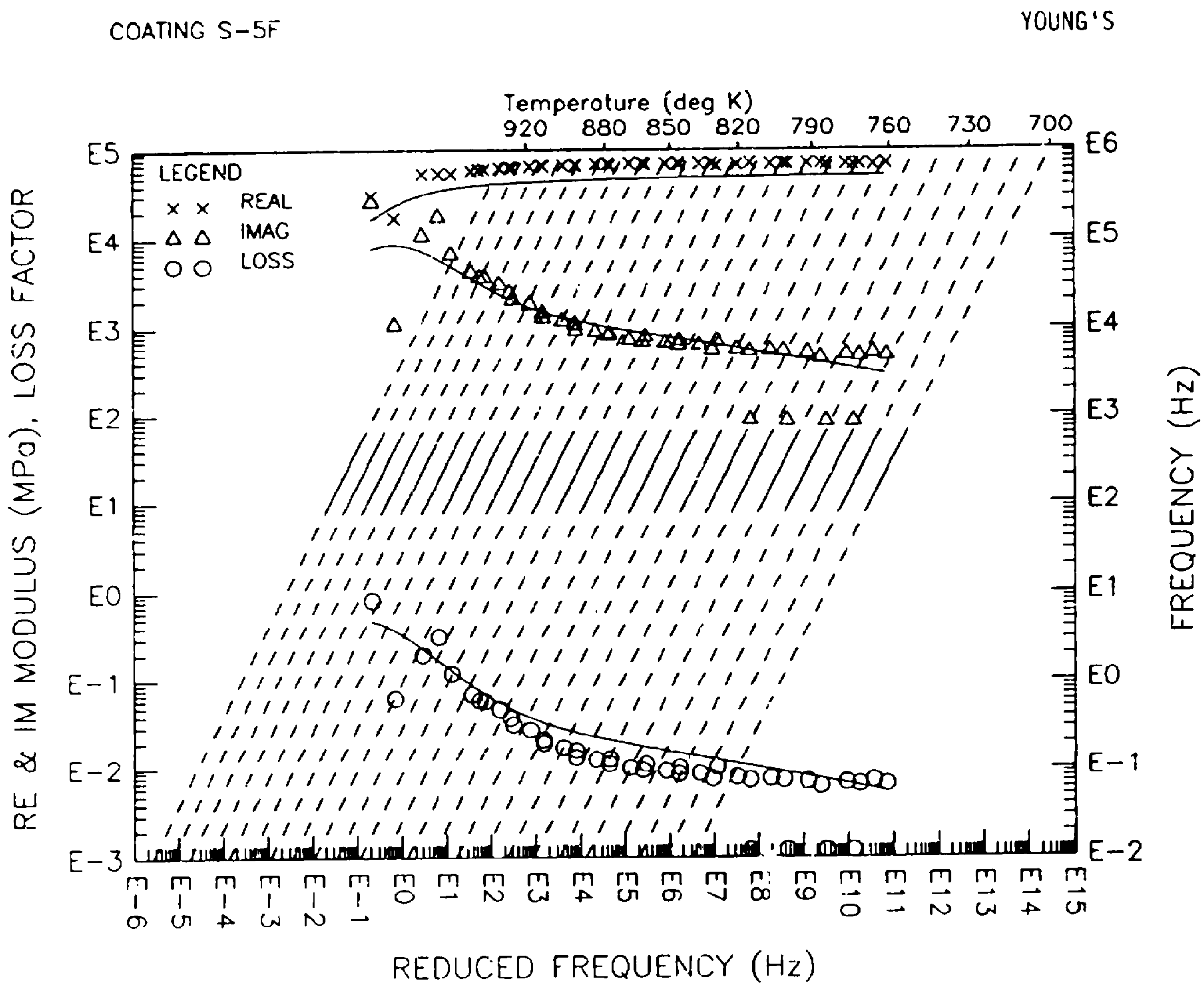
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
866.5	506.5	5150.	0.9109	4691.
866.5	1286.	0.1990E+05	0.4457	8869.
894.2	255.2	1990.	0.8652	1722.
894.2	502.0	3670.	0.7637	2803.
894.2	1251.	7130.	0.6198	4419.
838.8	516.4	0.1240E+05	0.6023	7469.
838.8	859.7	0.1580E+05	0.4850	7663.
838.8	1291.	0.1820E+05	0.3843	6994.
811.0	94.30	0.1140E+05	0.7049	8036.
811.0	267.1	0.1760E+05	0.4496	7913.
811.0	527.3	0.2180E+05	0.2917	6359.
811.0	875.4	0.2350E+05	0.2512	5903.
811.0	1311.	0.2480E+05	0.2115	5245.
783.2	95.50	0.1560E+05	0.4369	6816.
783.2	269.3	0.1950E+05	0.2957	5766.
783.2	531.6	0.2370E+05	0.1782	4223.
783.2	882.8	0.2530E+05	0.1709	4324.
783.2	1324.	0.2780E+05	0.1264	3514.
755.4	97.00	0.2250E+05	0.1988	4473.
755.4	272.9	0.2530E+05	0.1489	3767.
755.4	537.0	0.2750E+05	0.1102	3031.
755.4	890.8	0.2880E+05	0.1064	3064.
755.4	1338.	0.3190E+05	0.8200E-01	2616.
727.6	275.7	0.2890E+05	0.7600E-01	2196.
727.6	541.7	0.3050E+05	0.6950E-01	2120.
727.6	898.4	0.3170E+05	0.7700E-01	2441.
727.6	1348.	0.3420E+05	0.6110E-01	2090.
699.9	99.10	0.3080E+05	0.6540E-01	2014.
699.9	278.4	0.3270E+05	0.5050E-01	1651.
699.9	546.6	0.3370E+05	0.4580E-01	1543.
699.9	906.4	0.3490E+05	0.5130E-01	1790.
699.9	1360.	0.3740E+05	0.4560E-01	1705.
727.6	98.00	0.2660E+05	0.1042	2772.

COATING S-5F

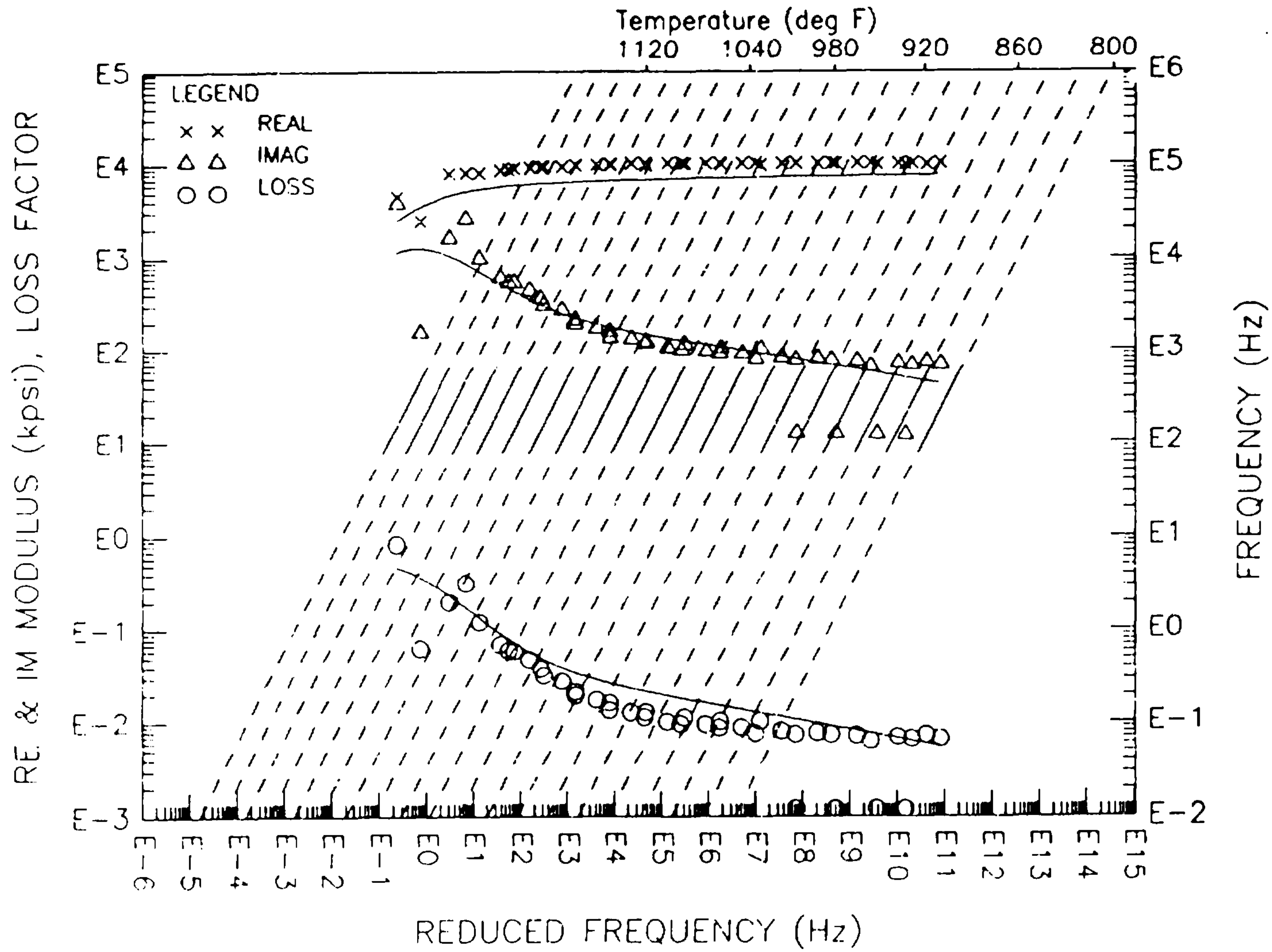
YOUNG'S

		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.5554E-02	0.3324	0.4748	0.3324	0.4748
MODULUS	MPA	0.5306E+05	0.2627E+05	0.1242E+05	7028.	0.1641E+05
	PSI	0.7696E+07	0.3810E+07	0.1802E+07	0.1019E+07	0.2380E+07
10.HZ	DEG K		870.0	893.0	915.0	
	DEG C		576.9	599.9	621.9	
	DEG F		1070.	1112.	1151.	
100.HZ	DEG K		892.0	916.0	930.0	
	DEG C		598.9	622.9	636.9	
	DEG F		1110.	1153.	1178.	
1000.HZ	DEG K		915.0	930.0	0.0000E+06	
	DEG C		621.9	636.9	-293.1	
	DEG F		1151.	1178.	-495.7	

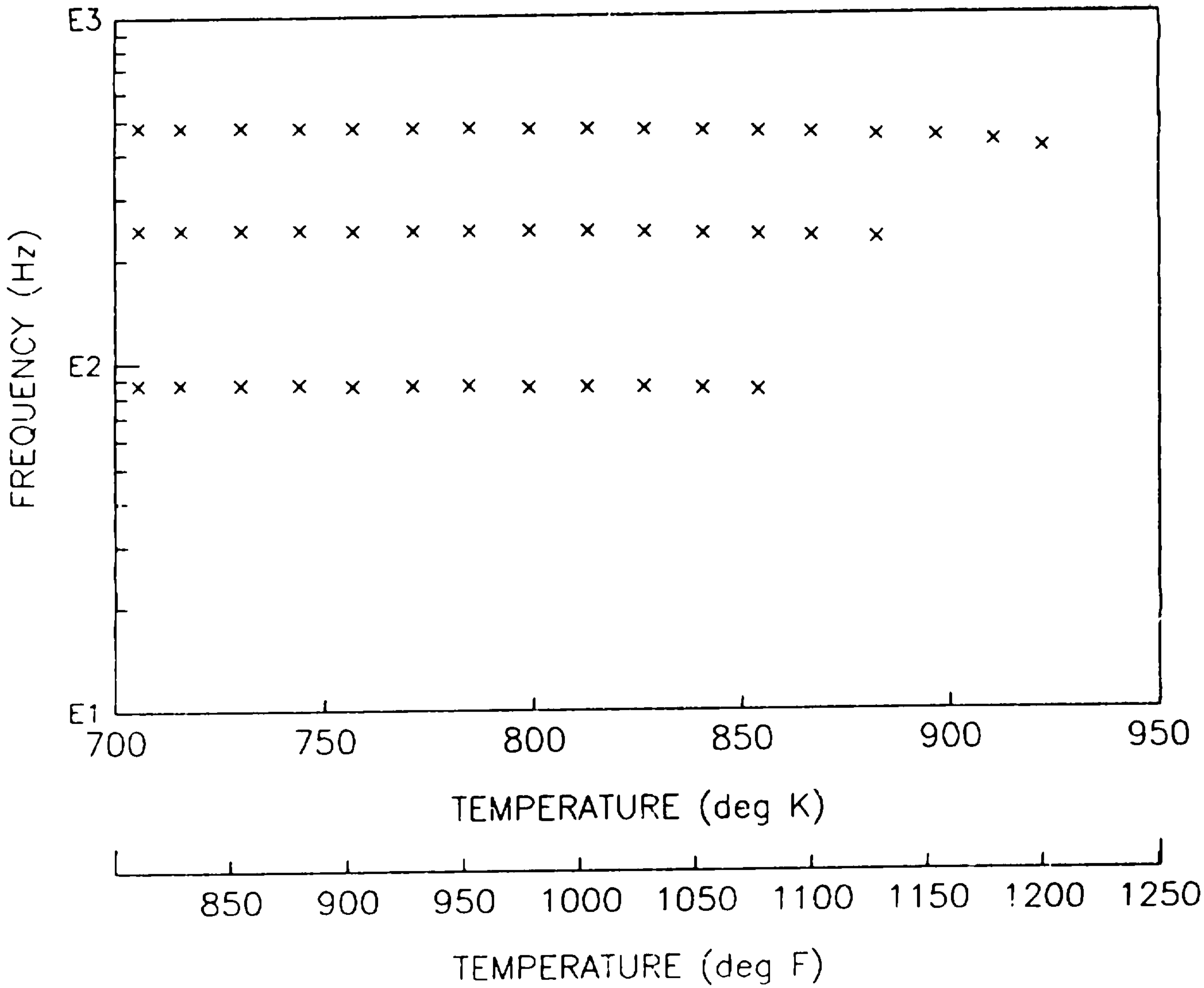

COATING S-5F
YOUNG'S
Temperature (deg K)
920 880 850 820 790 760 730 700
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
E5 E4 E3 E2 E1 E0 E−1 E−2 E−3
RE & IM MODULUS (MPa), LOSS FACTOR
E6 E5 E4 E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E−6 E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15
REDUCED FREQUENCY (Hz)

COATING S-5F

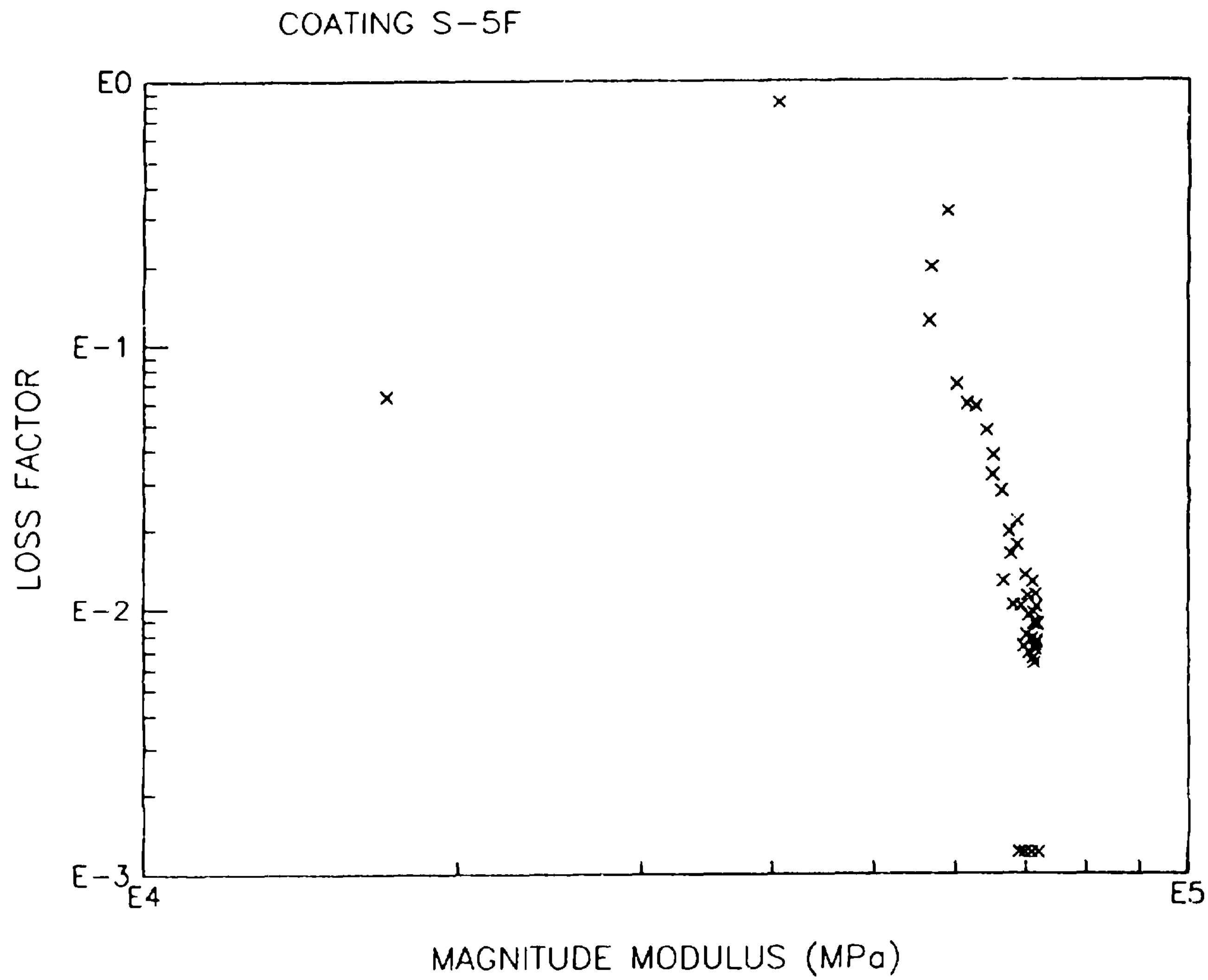
YOUNG'S

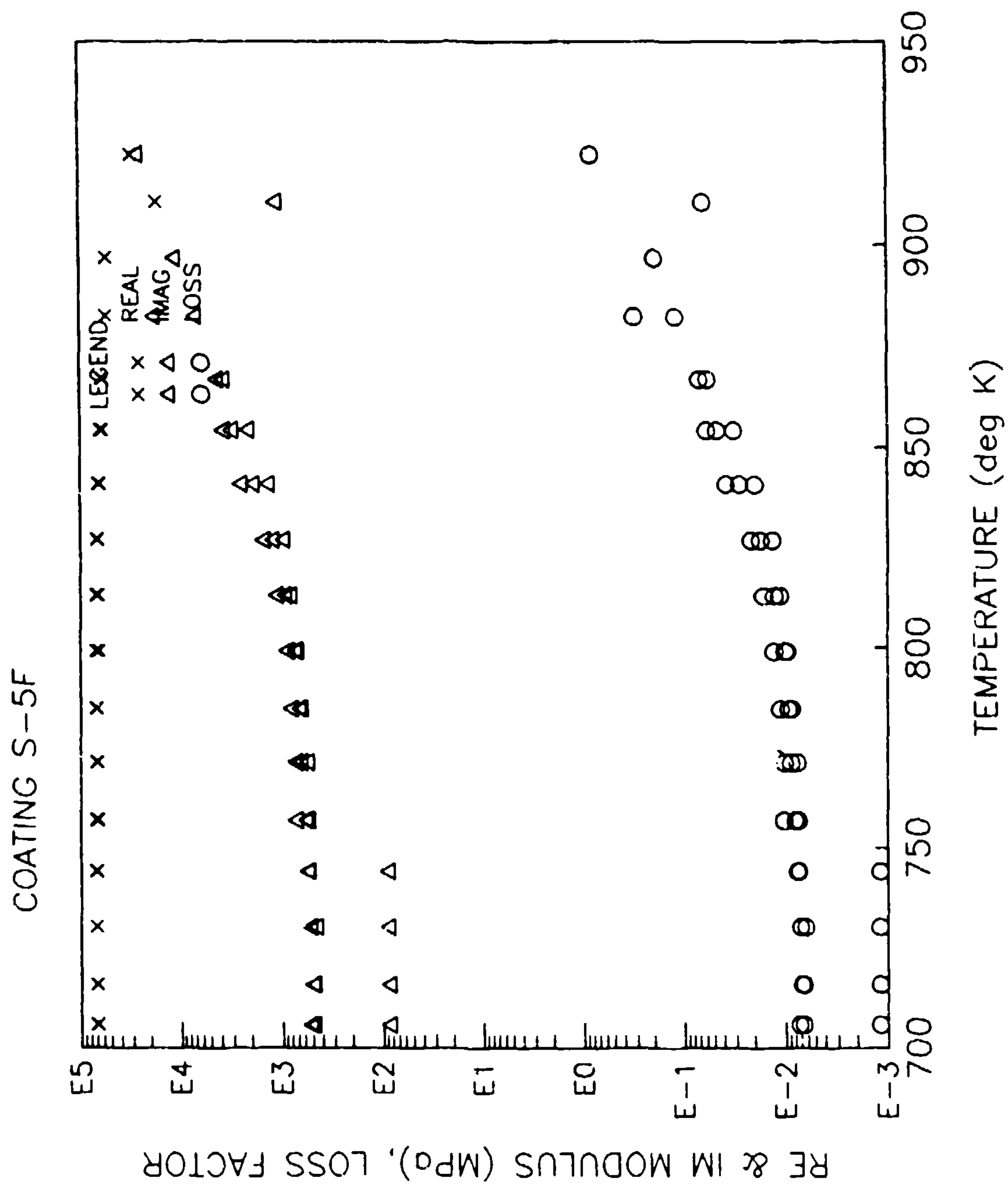


COATING S–5F

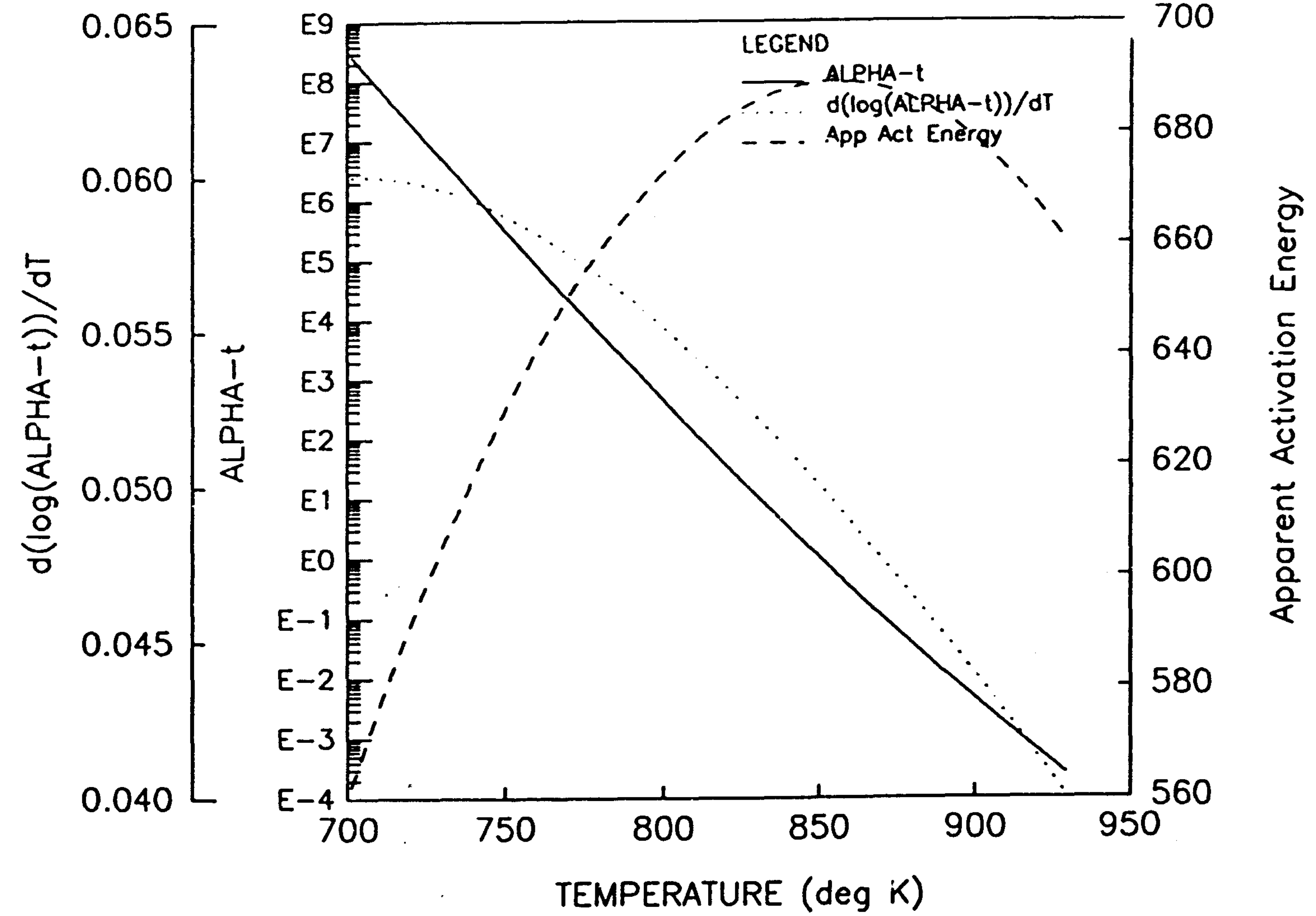


E3
E2
E1
FREQUENCY (Hz)
700
750
800
850
900
950
TEMPERATURE (deg K)
850
900
950
1000
1050
1100
1150
1200
1250
TEMPERATURE (deg F)


COATING S-5F
LOSS FACTOR
E0
E-1
E-2
E-3
E4
E5
MAGNITUDE MODULUS (MPa)


COATING S-5F
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
TEMPERATURE (deg K)
700
750
800
850
900
950

COATING S-5F



LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
0.065
0.060
0.055
0.050
0.045
0.040
d(log(ALPHA-t))/dT
ALPHA-t
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
700
750
800
850
900
950
TEMPERATURE (deg K)
700
680
660
640
620
600
580
560
Apparent Activation Energy

COATING S-5F YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	850.0	700.0	930.0	0.8000E-01	0.6000E-01	0.4000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	5000.	0.5000E+05	0.9000	0.6000	0.5000	0.1000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
705.4	87.00	0.6880E+05	0.1200E-02	82.56
705.4	244.0	0.6940E+05	0.7300E-02	506.6
705.4	480.0	0.7090E+05	0.6600E-02	467.9
715.4	87.00	0.6960E+05	0.1200E-02	83.52
715.4	244.0	0.7020E+05	0.6900E-02	484.4
715.4	479.0	0.7080E+05	0.6600E-02	467.3
729.9	87.00	0.7070E+05	0.1200E-02	84.84
729.9	244.0	0.7130E+05	0.7100E-02	506.2
729.9	478.0	0.7100E+05	0.6300E-02	447.3
743.8	87.00	0.7180E+05	0.1200E-02	86.16
743.8	243.0	0.7070E+05	0.7700E-02	544.4
743.8	477.0	0.7120E+05	0.7400E-02	526.9
756.5	86.00	0.6790E+05	0.1030E-01	699.4
756.5	242.0	0.6990E+05	0.8000E-02	559.2
756.5	476.0	0.7130E+05	0.7400E-02	527.6
771.0	86.00	0.6910E+05	0.1020E-01	704.8
771.0	242.0	0.7100E+05	0.8800E-02	624.8
771.0	475.0	0.7150E+05	0.7600E-02	543.4
784.3	86.00	0.7010E+05	0.1120E-01	785.1
784.3	241.0	0.7030E+05	0.9400E-02	660.8
784.3	474.0	0.7170E+05	0.8700E-02	623.8
798.7	85.00	0.6640E+05	0.1280E-01	849.9
798.7	241.0	0.7150E+05	0.1010E-01	722.1
798.7	472.0	0.7100E+05	0.9600E-02	681.6
812.6	85.00	0.6750E+05	0.1610E-01	1087.
812.6	240.0	0.7080E+05	0.1270E-01	899.2
812.6	471.0	0.7130E+05	0.1130E-01	805.7
826.4	238.0	0.6850E+05	0.1740E-01	1192.
826.4	468.0	0.6970E+05	0.1340E-01	934.0
840.4	84.00	0.6490E+05	0.3800E-01	2466.
840.4	236.0	0.6610E+05	0.2790E-01	1844.
840.4	464.0	0.6730E+05	0.1960E-01	1319.
853.8	83.00	0.6120E+05	0.5970E-01	3654.
853.8	234.0	0.6380E+05	0.4740E-01	3024.
853.8	460.0	0.6480E+05	0.3210E-01	2080.
866.5	231.0	0.5980E+05	0.6990E-01	4180.
866.5	456.0	0.6240E+05	0.5840E-01	3644.
882.1	228.0	0.5600E+05	0.3170	0.1775E+05
882.1	447.0	0.5600E+05	0.1217	6815.
896.4	445.0	0.5550E+05	0.1986	0.1102E+05

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
910.3	430.0	0.1700E+05	0.6350E-01	1080.
922.1	412.0	0.3110E+05	0.8295	0.2580E+05
826.4	85.00	0.6850E+05	0.2150E-01	1473.

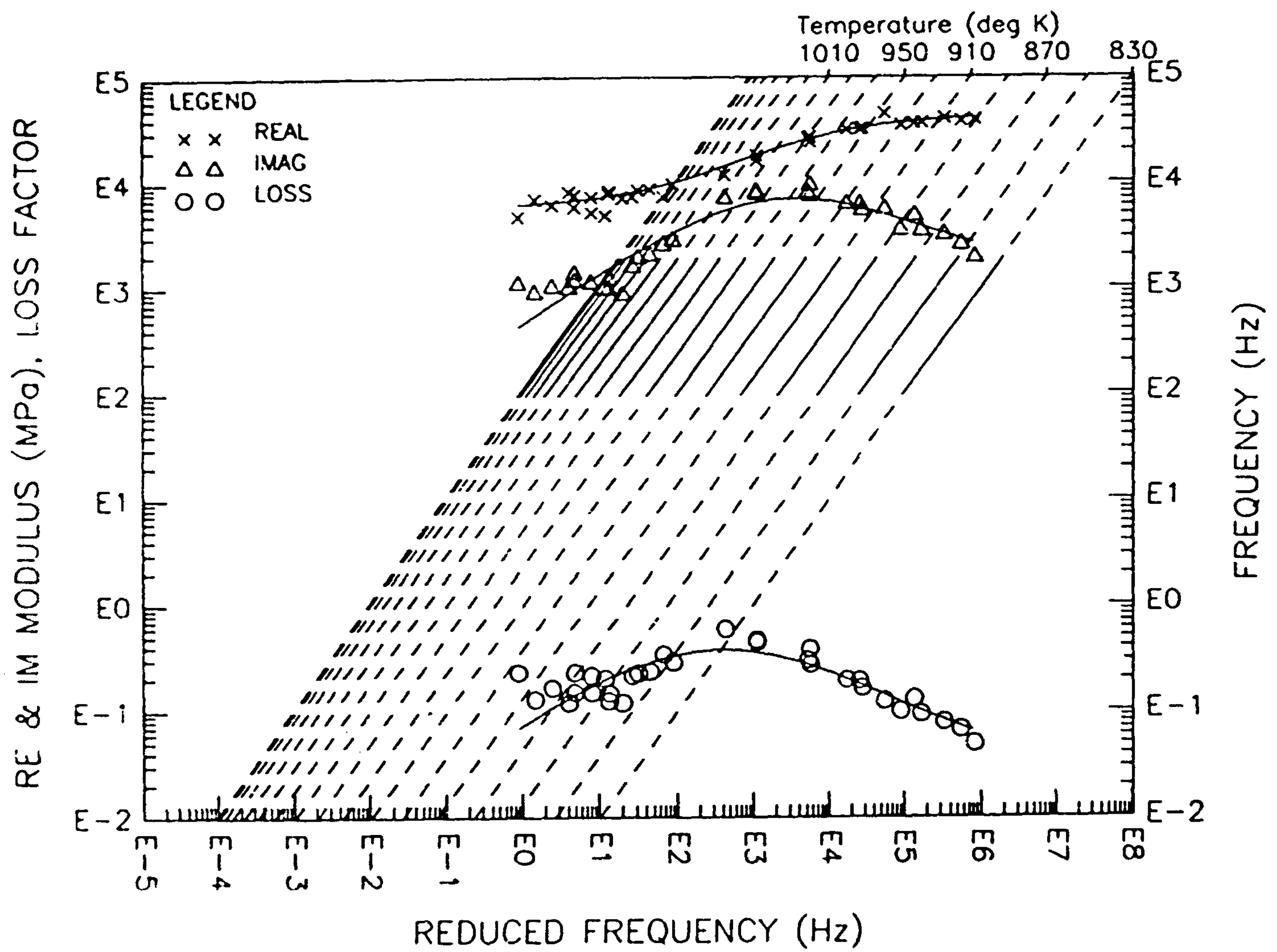
CORNING 0010

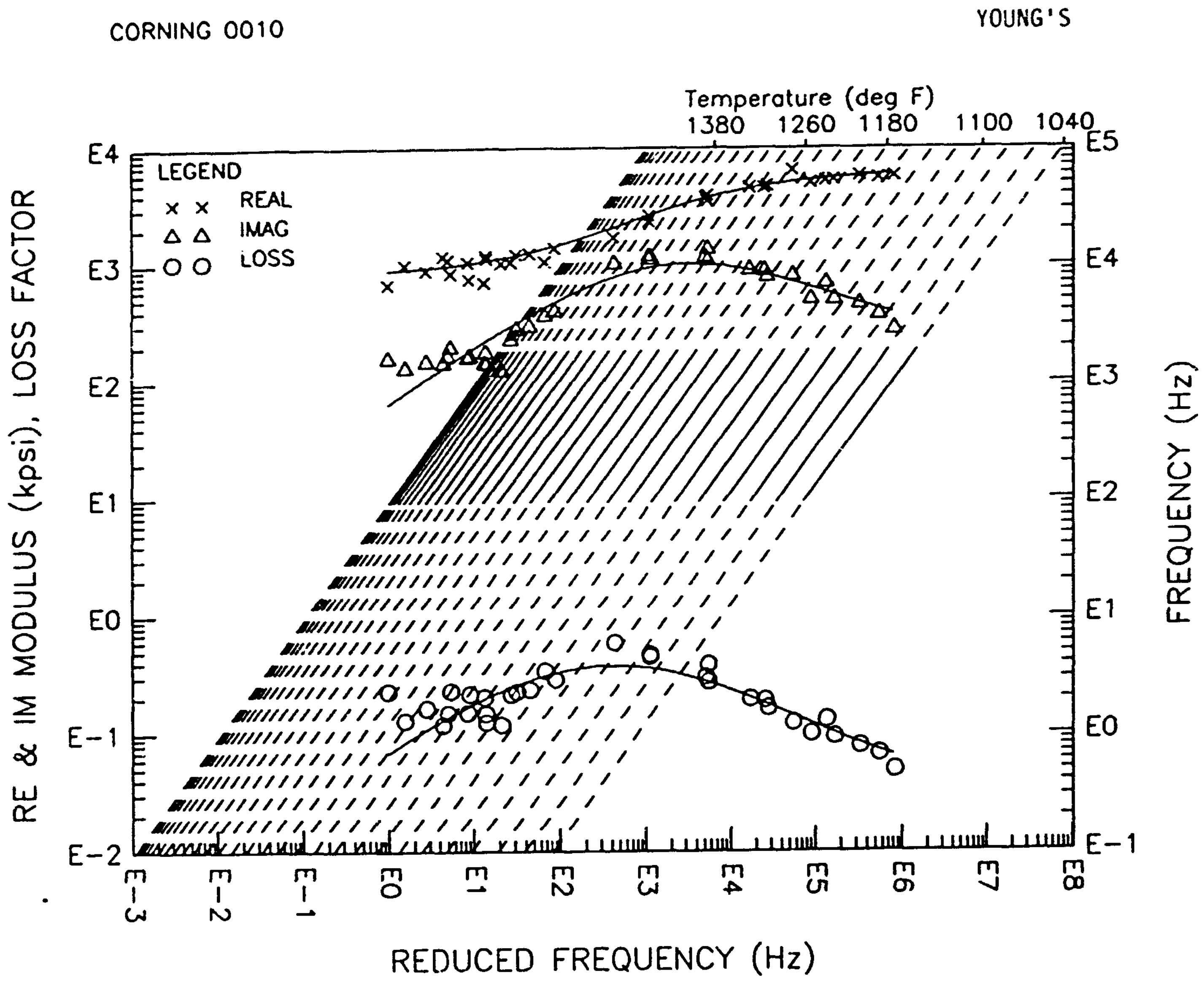
YOUNG'S

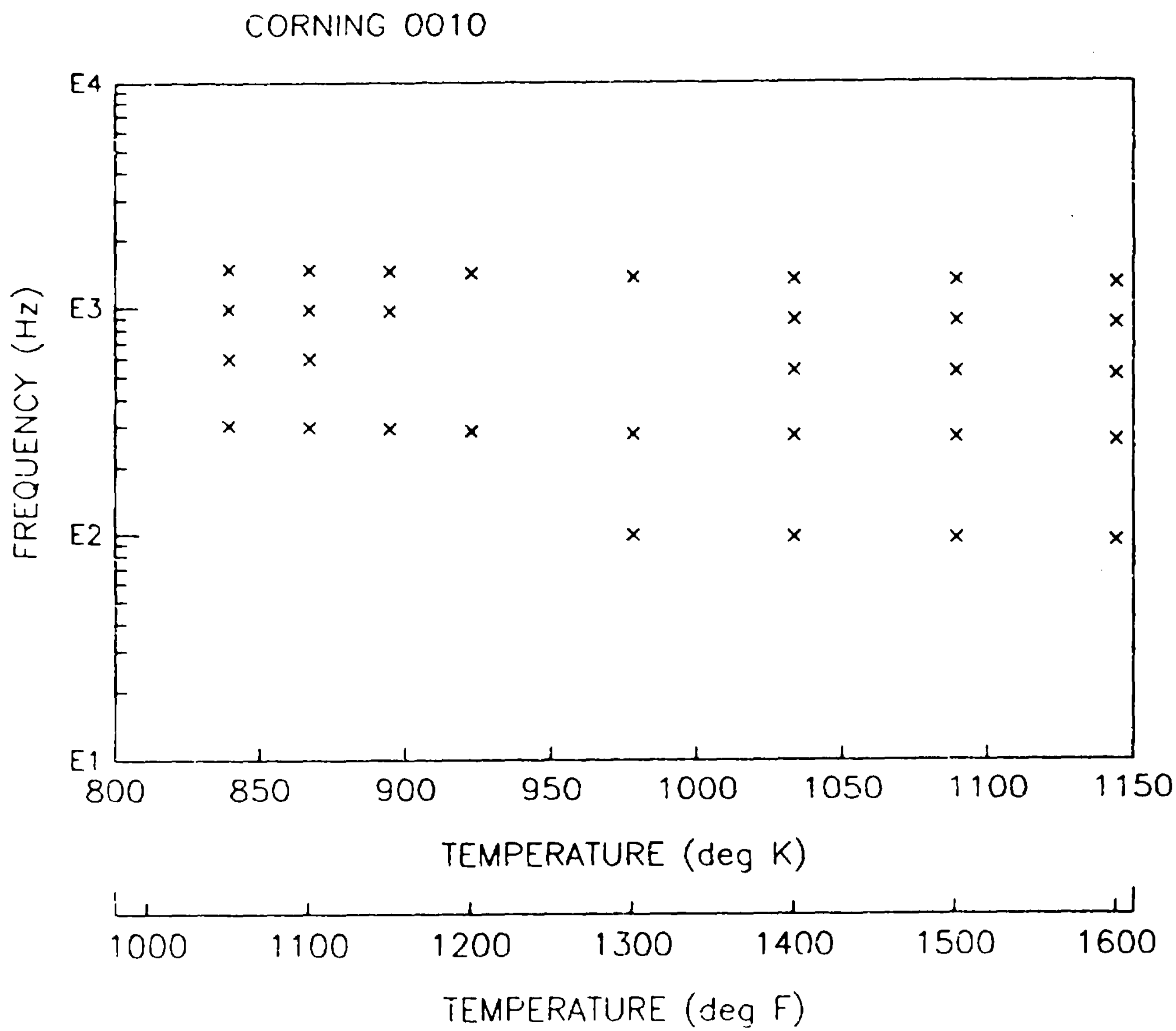
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.6436E-01	0.2633	0.3761	0.2633	0.6883E-01
MODULUS	MPA	0.4094E+05	0.2621E+05	0.1404E+05	8336.	6174.
	PSI	0.5938E+07	0.3802E+07	0.2036E+07	0.1209E+07	0.8954E+06
10.HZ	DEG K		837.0	880.0	926.0	
	DEG C		543.9	586.9	632.9	
	DEG F		1011.	1088.	1171.	
100.HZ	DEG K		873.0	921.0	977.0	
	DEG C		579.9	627.9	683.9	
	DEG F		1076.	1162.	1263.	
1000.HZ	DEG K		913.0	971.0	1051.	
	DEG C		619.9	677.9	757.9	
	DEG F		1148.	1252.	1396.	

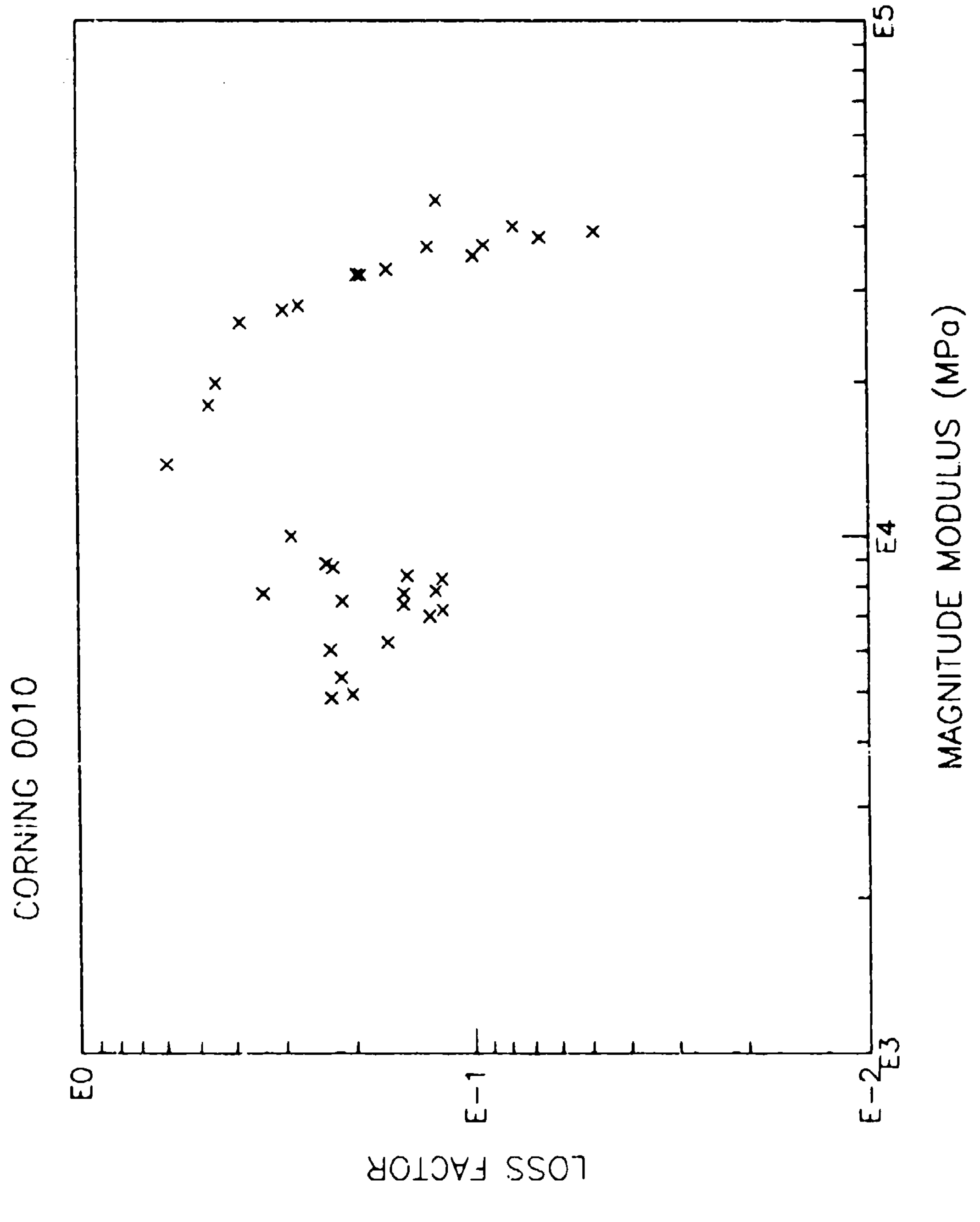
CORNING 0010

YOUNG'S



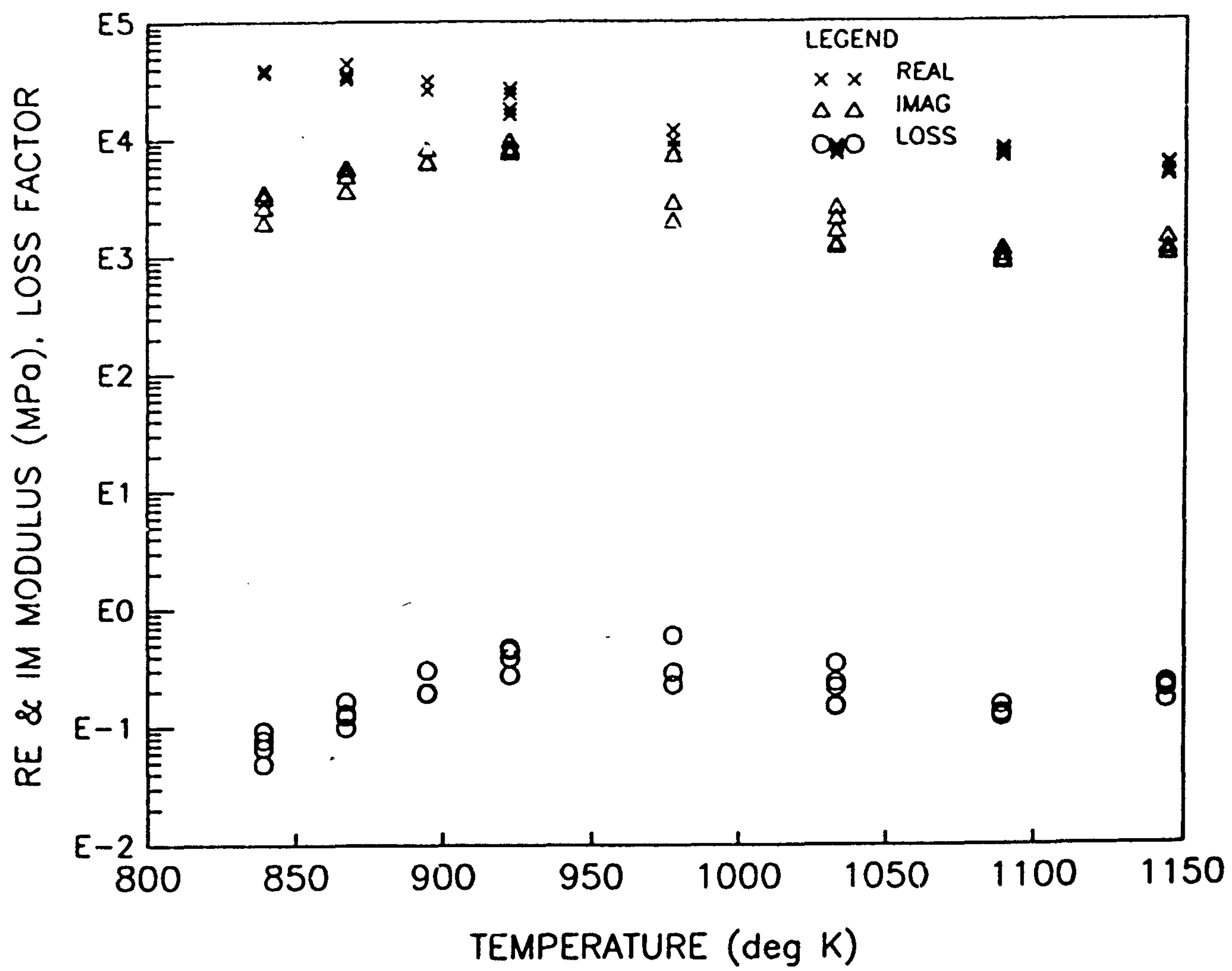

CORNING 0010
YOUNG'S
Temperature (deg F)
1380 1260 1180 1100 1040
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (kpsi), LOSS FACTOR
E4 E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E5 E4 E3 E2 E1 E0 E−1
E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8
REDUCED FREQUENCY (Hz)


CORNING 0010
FREQUENCY (Hz)
E4
E3
E2
E1
800
850
900
950
1000
1050
1100
1150
TEMPERATURE (deg K)
1000
1100
1200
1300
1400
1500
1600
TEMPERATURE (deg F)



CORNING 0010
LOSS FACTOR
E0
E−1
E−2
E3
E4
E5
MAGNITUDE MODULUS (MPa)

CORNING 0010



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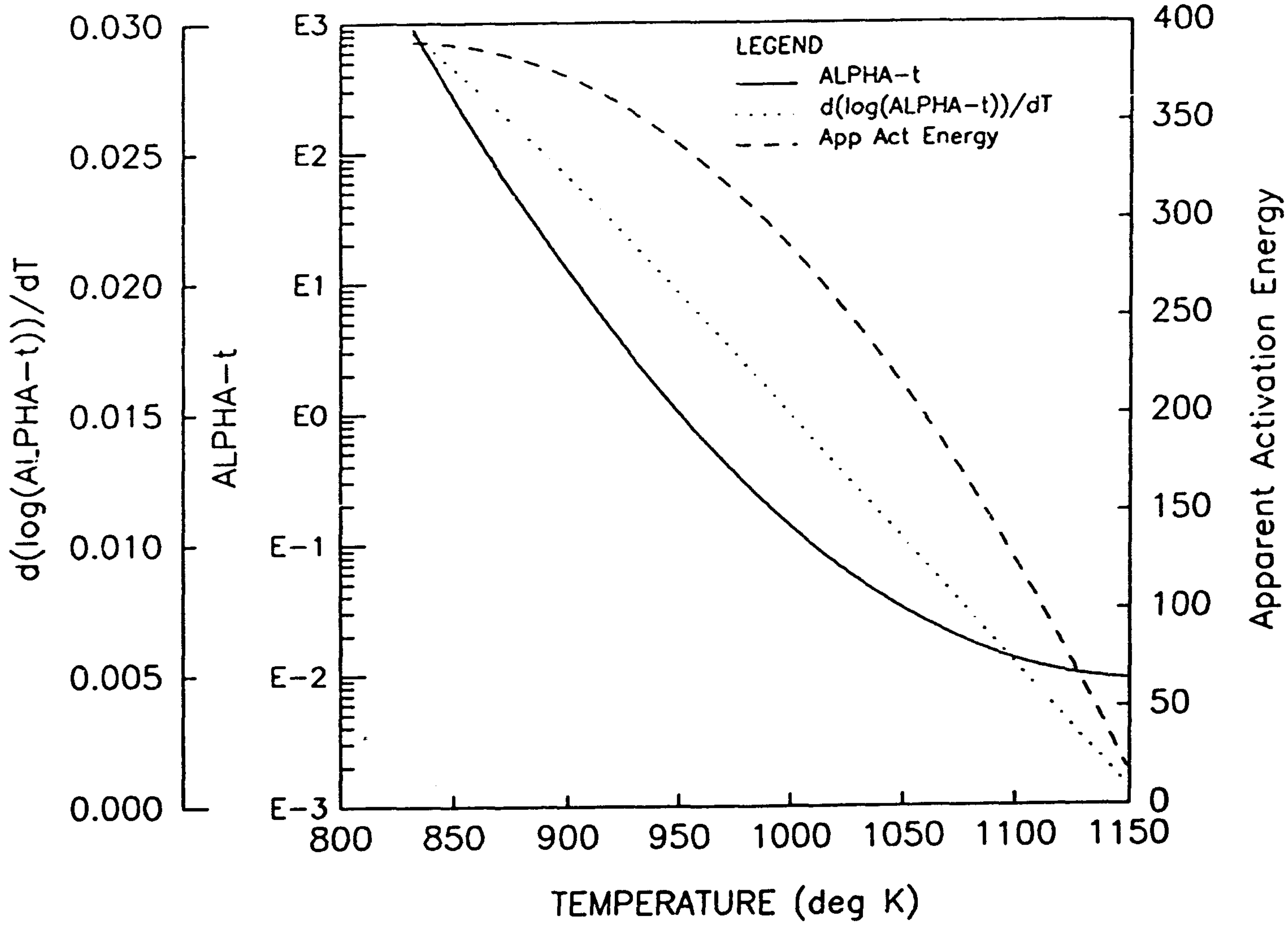


CORNING 0010 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	950.0	830.0	1150.	0.1962E-01	0.2971E-01	0.6288E-03

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	5734.	0.7166E+05	0.1164E+05	0.4990	1.136	0.4467E-01

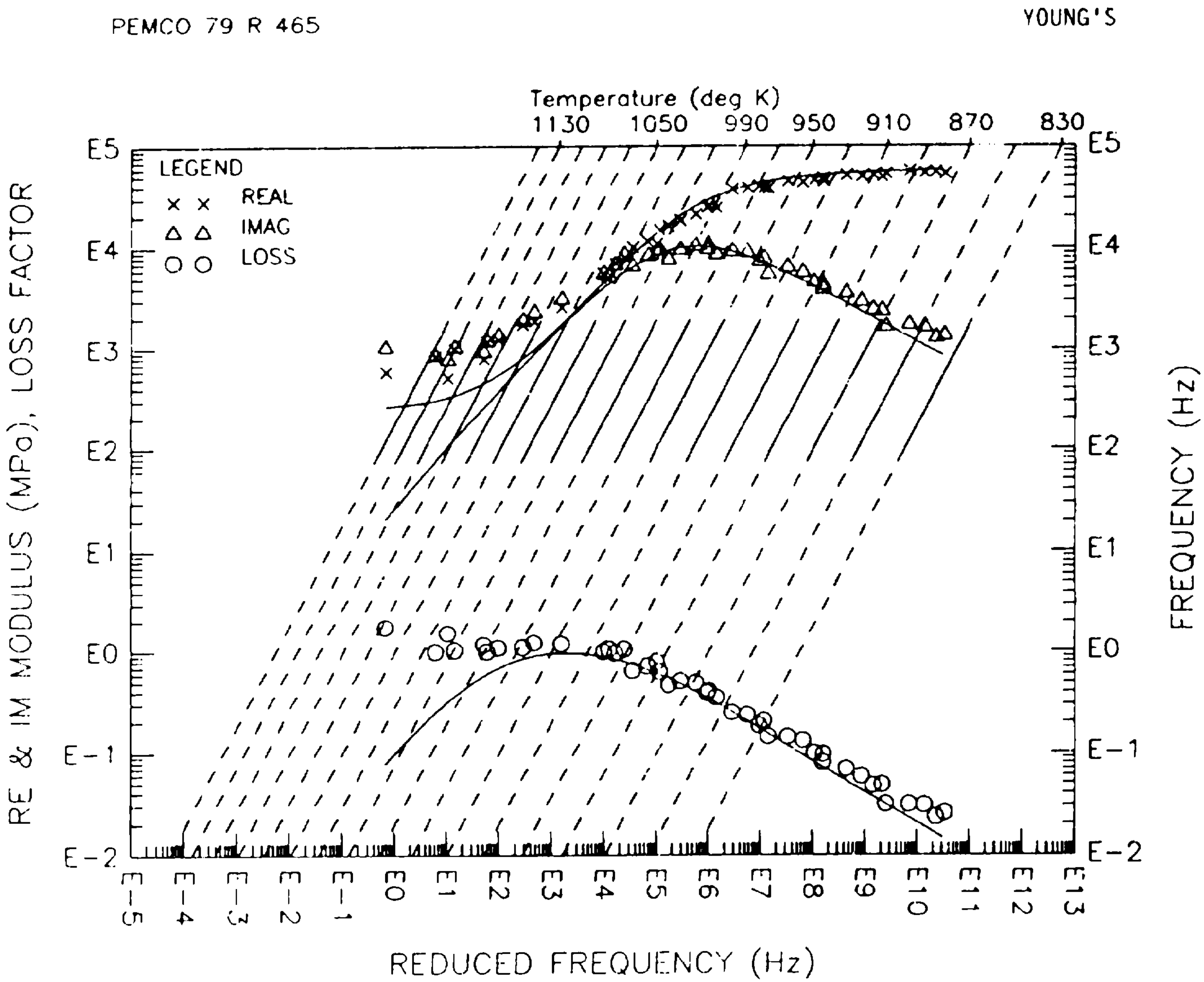
COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

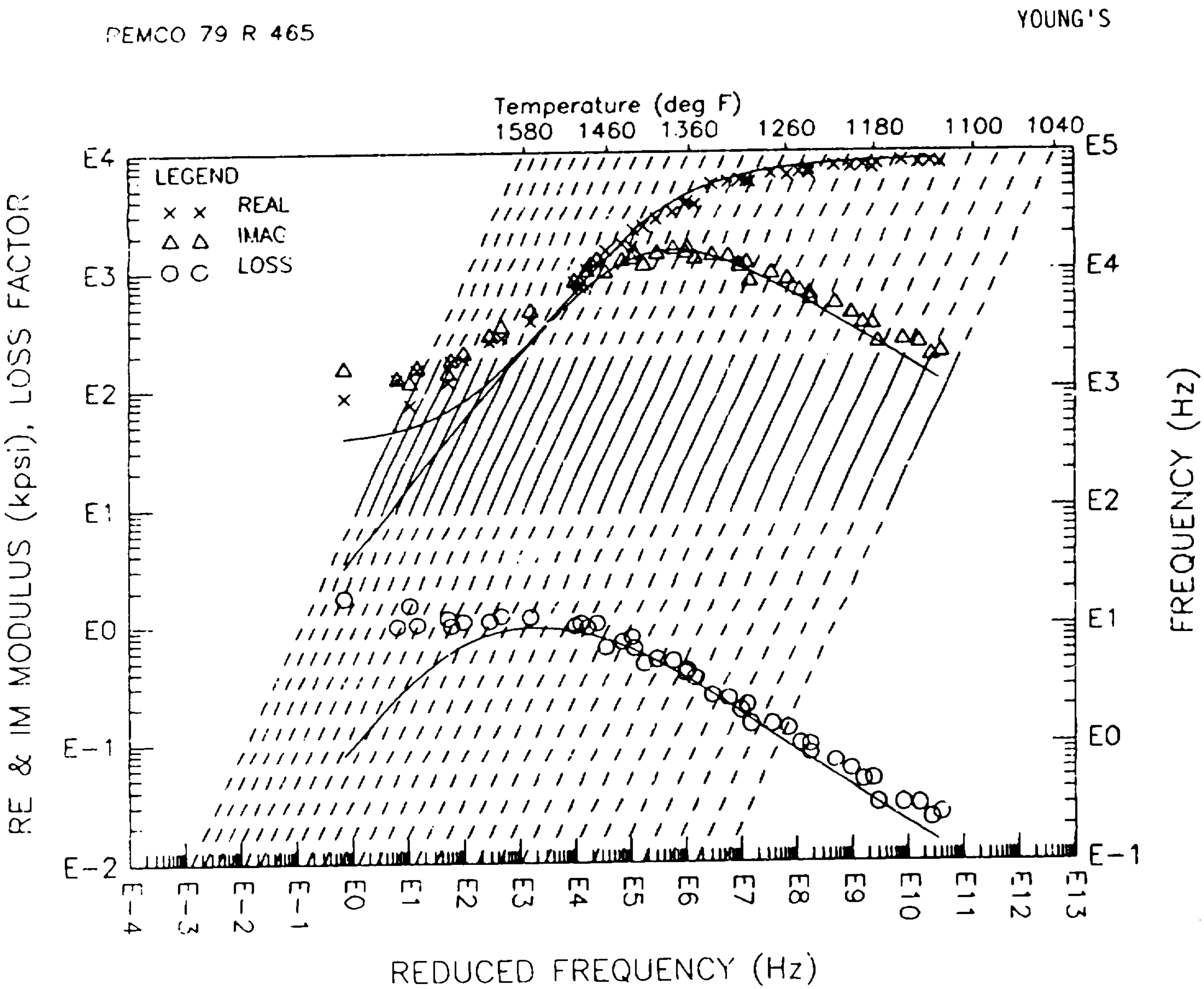
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
1144.	93.10	4720.	0.2298	1085.
1144.	261.7	6120.	0.1648	1009.
1144.	512.6	5850.	0.2308	1350.
1144.	851.1	5180.	0.2171	1125.
1144.	1275.	4830.	0.2036	983.4
1089.	95.40	6920.	0.1294	895.4
1089.	268.0	8180.	0.1200	981.6
1089.	524.7	7260.	0.1509	1096.
1089.	870.8	7740.	0.1247	965.2
1089.	1304.	7110.	0.1196	850.4
1033.	97.20	7630.	0.1504	1148.
1033.	272.8	8250.	0.1473	1215.
1033.	533.9	7290.	0.2159	1574.
1033.	1327.	7290.	0.3413	2488.
1033.	886.8	8580.	0.2361	2026.
977.6	99.10	8440.	0.2272	1918.
977.6	278.1	9580.	0.2888	2767.
977.6	1361.	0.1180E+05	0.5934	7002.
922.1	287.3	0.1800E+05	0.4463	8033.
922.1	1423.	0.2690E+05	0.2741	7373.
922.1	286.2	0.1620E+05	0.4669	7564.
922.1	1415.	0.2410E+05	0.3843	9262.
894.2	293.9	0.2620E+05	0.3022	7918.
894.2	965.5	0.3140E+05	0.1962	6161.
894.2	1444.	0.3140E+05	0.1916	6016.
866.5	299.2	0.3240E+05	0.1642	5320
866.5	977.2	0.3470E+05	0.9920E-01	3442
866.5	1465.	0.3600E+05	0.1302	4687.
838.8	303.0	0.3640E+05	0.9340E-01	3400.
838.8	598.0	C.3960E+05	0.7820E-01	3097.
838.8	988.0	0.3780E+05	0.6700E-01	2533.
838.8	1480.	0.3880E+05	0.4870E-01	1890.
866.5	599.5	0.4430E+05	0.1233	5462.

PEMCO 79 R 465

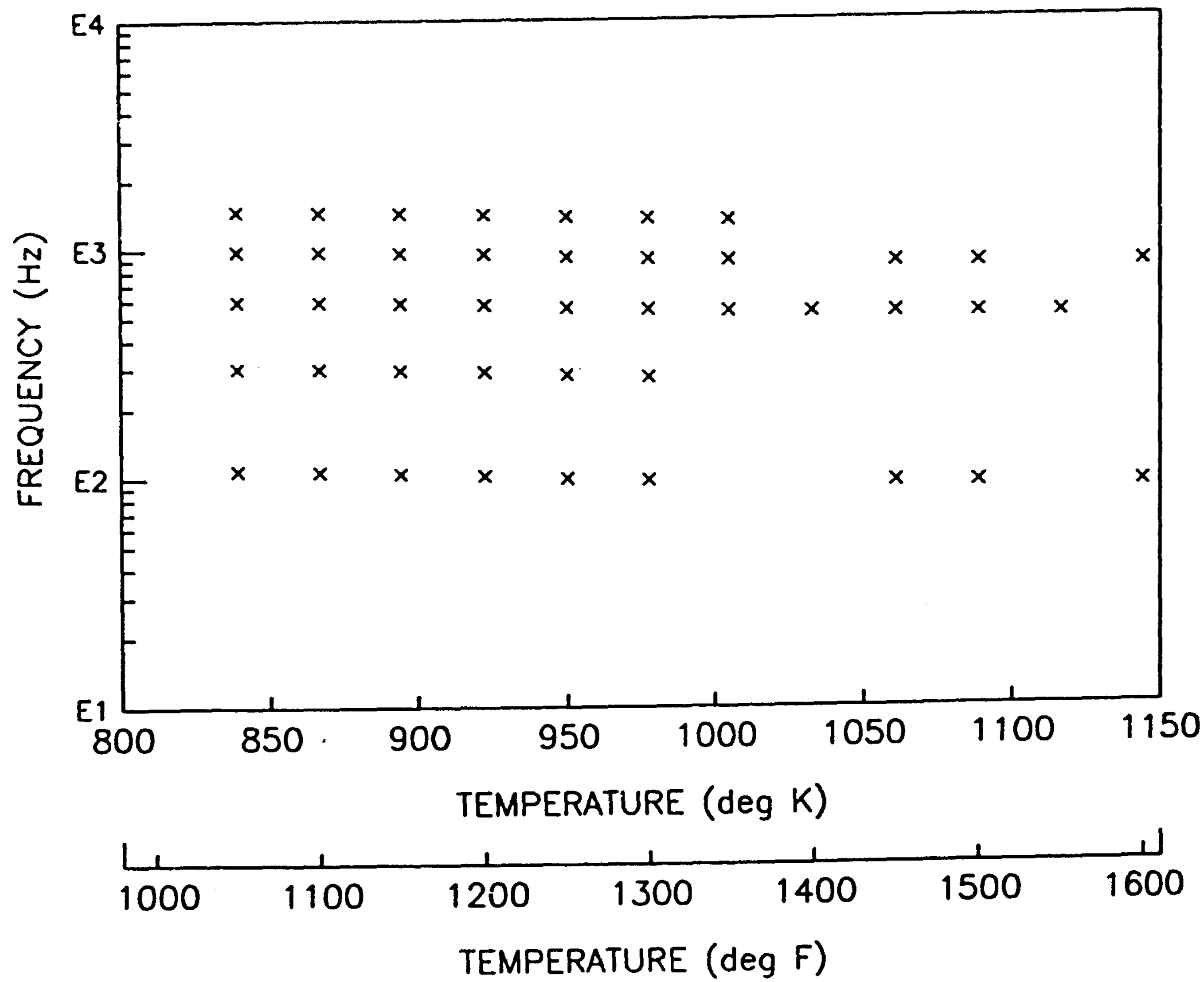
YOUNG'S

		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1426E-01	0.6711	0.9587	0.6711	0.7814E-01
MODULUS	MPA	0.5849E+05	0.1196E+05	1897.	531.2	265.3
	PSI	0.8484E+07	0.1734E+07	0.2752E+06	0.7704E+05	0.3848E+05
	DEG K		926.0	973.0	1016.	
10.HZ	DEG C		632.9	679.9	722.9	
	DEG F		1171.	1256.	1333.	
	DEG K		955.0	1005.	1052.	
100.HZ	DEG C		661.9	711.9	758.9	
	DEG F		1223.	1313.	1398.	
	DEG K		986.0	1041.	1093.	
1000.HZ	DEG C		692.9	747.9	799.9	
	DEG F		1279.	1378.	1472.	

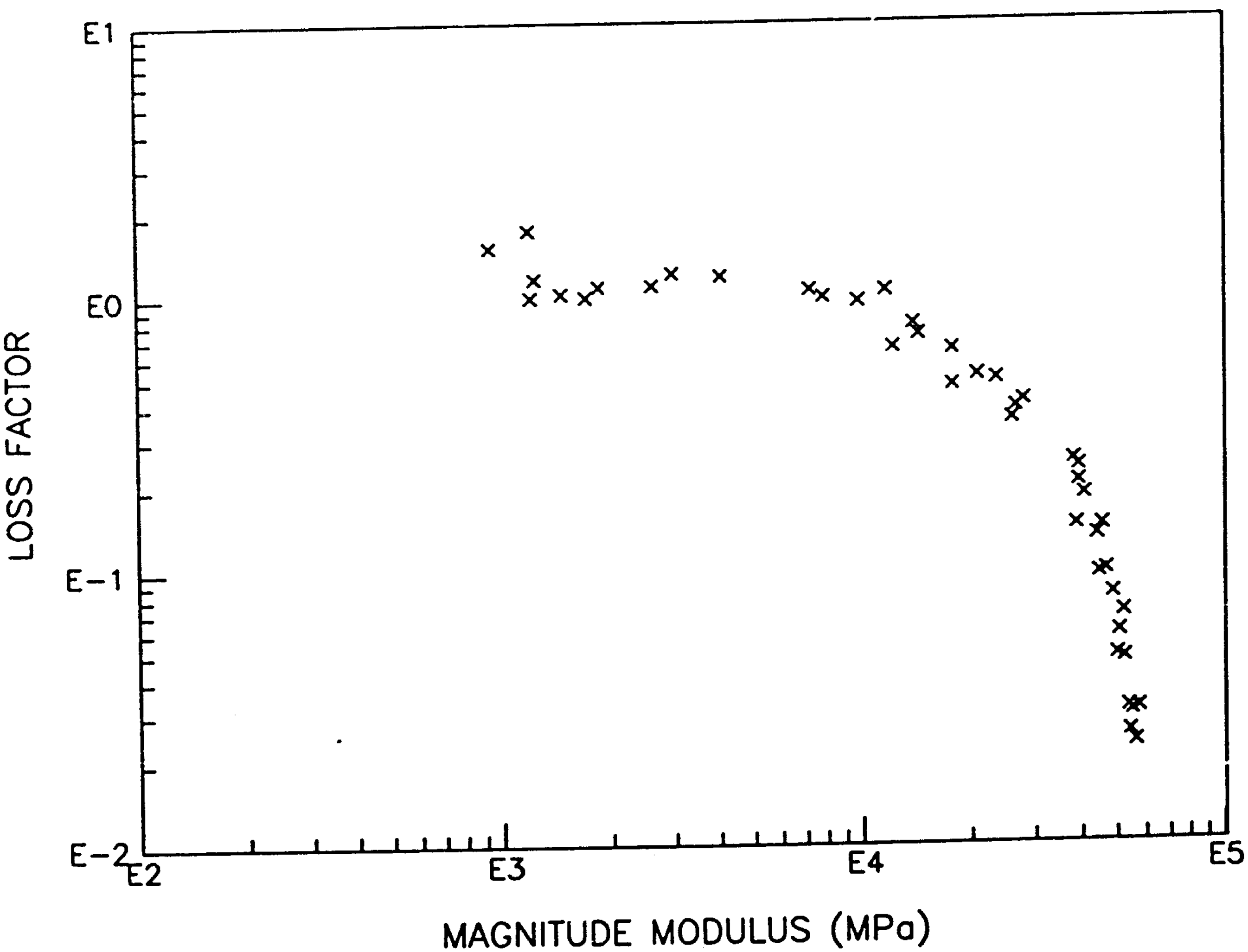

PEMCO 79 R 465
YOUNG'S
Temperature (deg K)
1130 1050 990 950 910 870 830
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5 E4 E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13
REDUCED FREQUENCY (Hz)

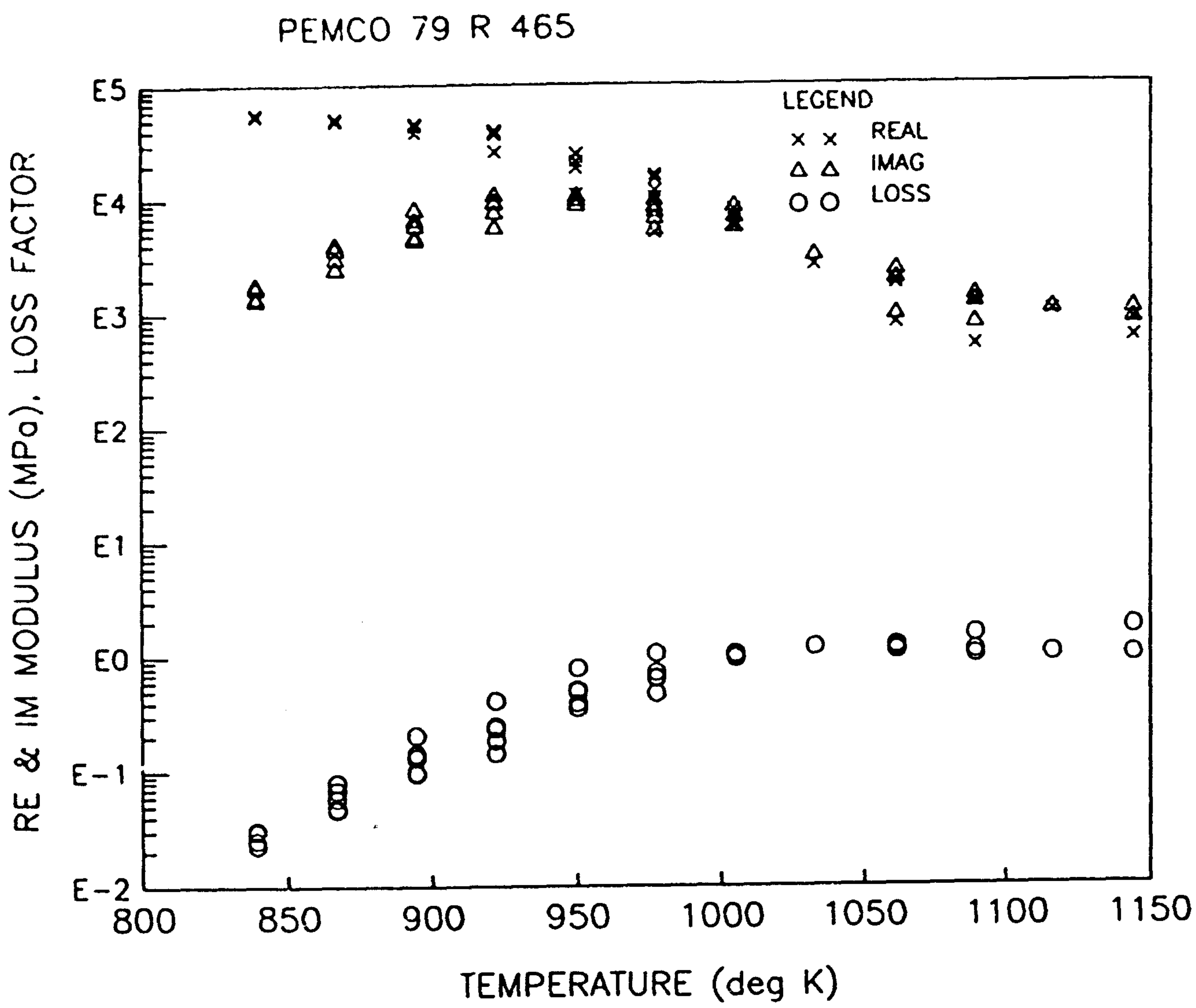

PEMCO 79 R 465
YOUNG'S
Temperature (deg F)
1580
1460
1360
1260
1180
1100
1040
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
E4
E3
E2
E1
E0
E−1
E−2
RE & IM MODULUS (kpsi), LOSS FACTOR
E5
E4
E3
E2
E1
E0
E−1
FREQUENCY (Hz)
E−4
E−3
E−2
E−1
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
REDUCED FREQUENCY (Hz)

PEMCO 79 R 465

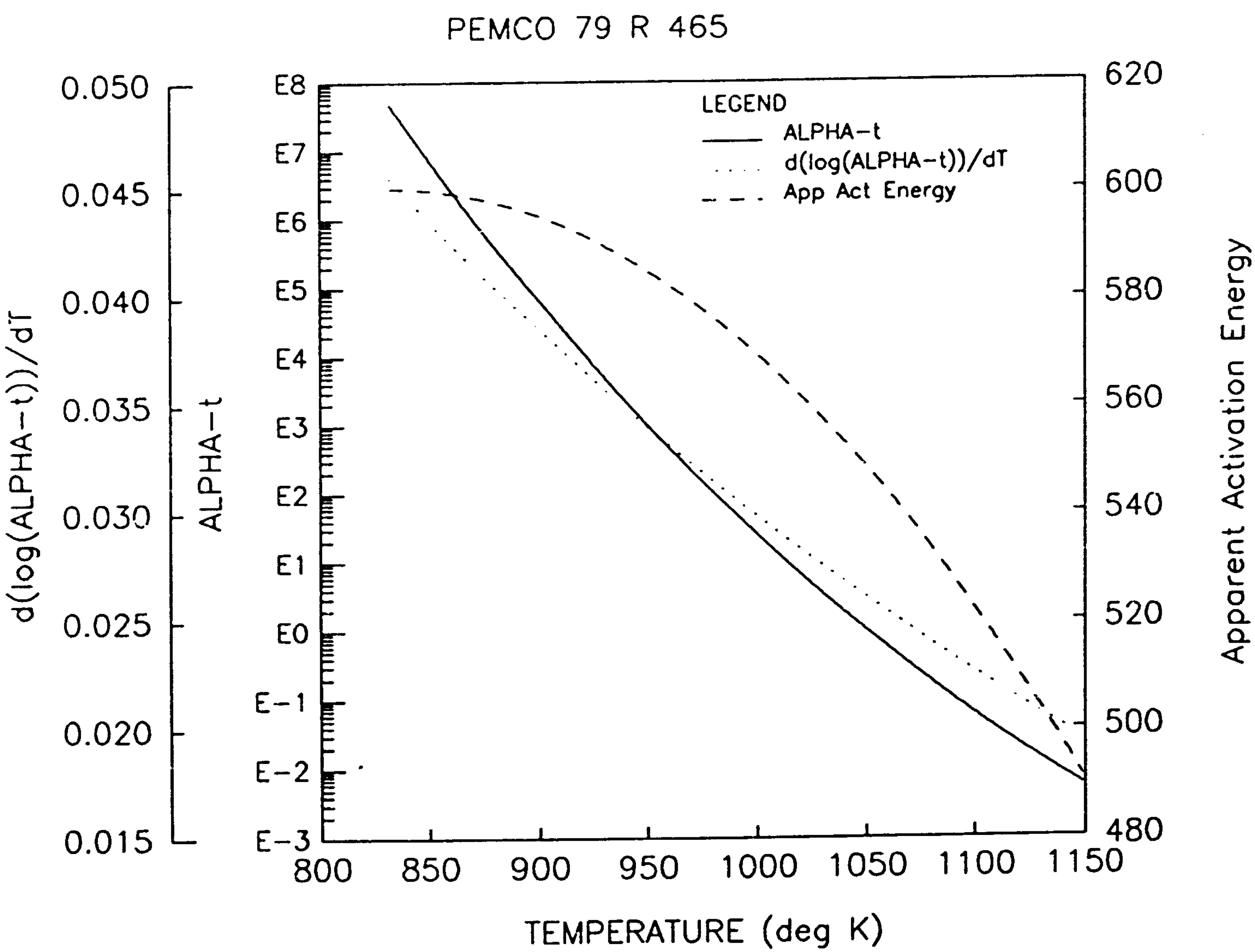


PEMCO 79 R 465





PEMCO 79 R 465
LEGEND
REAL
IMAG
LOSS
E5
E4
E3
E2
E1
E0
E−1
E−2
800
850
900
950
1000
1050
1100
1150
TEMPERATURE (deg K)
RE & IM MODULUS (MPa), LOSS FACTOR



PEMCO 79 R 465
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
ALPHA-t
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
Apparent Activation Energy
620
600
580
560
540
520
500
480
800
850
900
950
1000
1050
1100
1150
TEMPERATURE (deg K)

PEMCO 79 R 465 YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	3	1080.	830.0	1150.	0.2608E-01	0.4570E-01	0.1944E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	250.0	0.6000E+05	0.2604E+06	0.6000	0.9105	0.2835

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

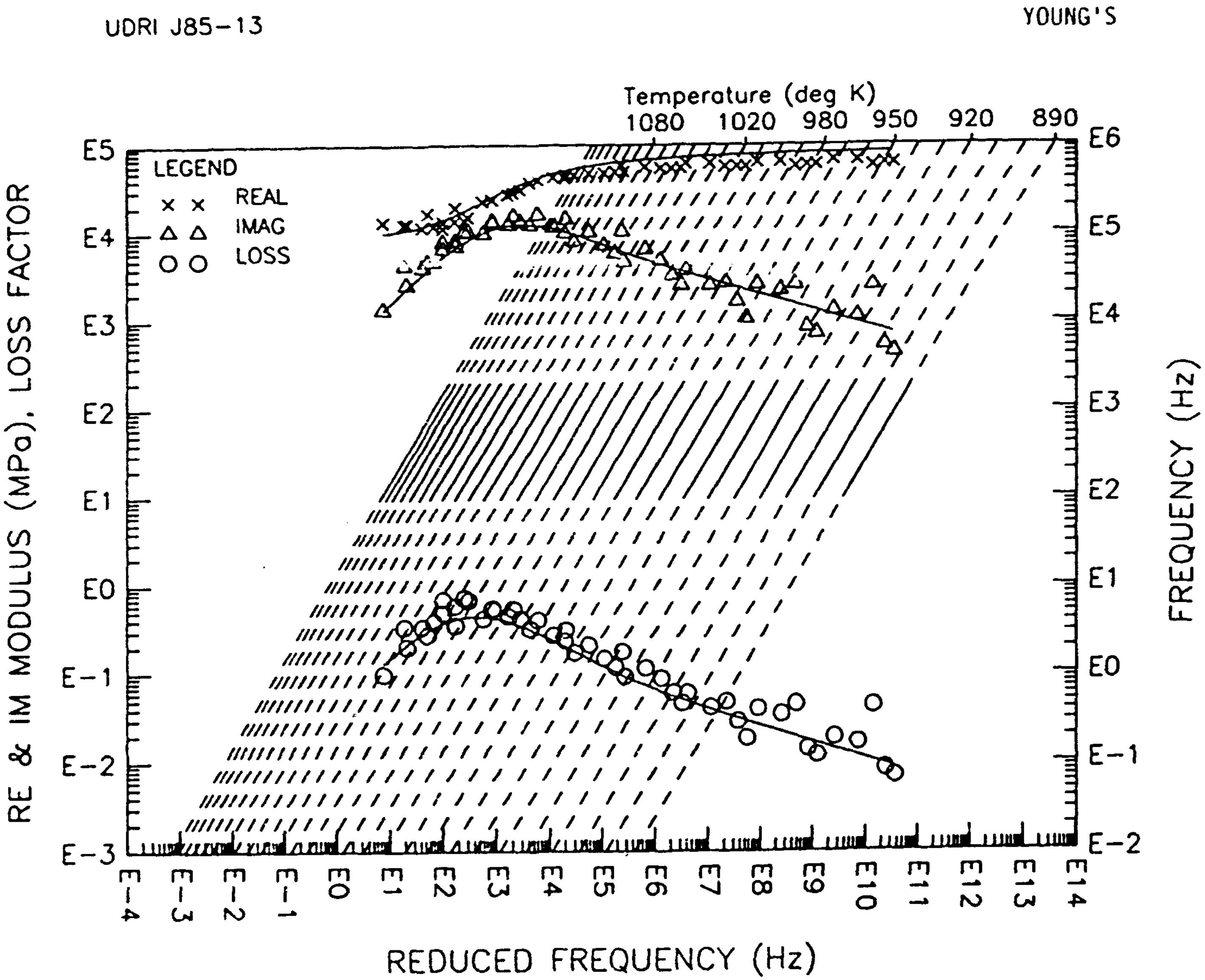
Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
1144.	92.10	586.0	1.752	1027.
1144.	842.6	846.0	0.9960	842.6
1116.	512.7	1010.	1.030	1040.
1089.	93.80	510.0	1.521	775.7
1089.	517.1	1200.	0.9999	1200.
1089.	856.7	1250.	1.088	1360.
1061.	94.60	798.0	1.167	931.3
1033.	526.2	2610.	1.188	3101.
1005.	532.8	5600.	0.9932	5562.
1005.	884.4	7080.	0.9554	6764.
1005.	1328.	8030.	1.046	8399.
977.6	1354.	0.1610E+05	0.4704	7573.
977.6	901.7	0.1500E+05	0.6349	9524.
977.6	541.9	0.1160E+05	0.7176	8324.
977.6	275.7	0.1020E+05	0.6478	6608.
977.6	97.50	4990.	1.053	5254.
949.9	99.10	0.1090E+05	0.7867	8575.
948.9	281.2	0.1860E+05	0.5091	9469.
949.9	553.9	0.2120E+05	0.4923	0.1044E+05
949.9	921.2	0.2480E+05	0.3886	9637.
949.9	1380.	0.2450E+05	0.3520	8624.
922.1	1416.	0.3830E+05	0.1433	5488.
922.1	946.7	0.4000E+05	0.1845	7392.
922.1	571.0	0.3830E+05	0.2343	8974.
922.1	290.5	0.3700E+05	0.2476	9161.
922.1	102.0	0.2590E+05	0.4098	0.1061E+05
894.2	104.4	0.3860E+05	0.2056	7916.
894.2	295.3	0.4490E+05	0.1424	6394.
894.2	578.6	0.4350E+05	0.1313	5712.
894.2	980.0	0.4610E+05	0.9790E-01	4513.
894.2	1436.	0.4430E+05	0.9570E-01	4240.
866.5	1453.	0.4960E+05	0.4790E-01	2371.
866.5	586.8	0.5030E+05	0.5810E-01	2922.
866.5	299.4	0.5160E+05	0.6870E-01	3545.
866.5	108.4	0.4820E+05	0.8020E-01	3868.
838.8	107.6	0.5340E+05	0.3080E-01	1645.
838.8	302.7	0.5680E+05	0.3060E-01	1738.
838.8	593.0	0.5460E+05	0.3000E-01	1638.
838.8	982.4	0.5570E+05	0.2300E-01	1281.
838.8	1468.	0.5370E+05	0.2520E-01	1353.

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
1061	521.5	1760.	1.098	1932.
1061.	864.2	1890.	1.217	2300.
866.5	972.4	0.5180E+05	0.4680E-01	2424.

UDR J85-13

YOUNG'S

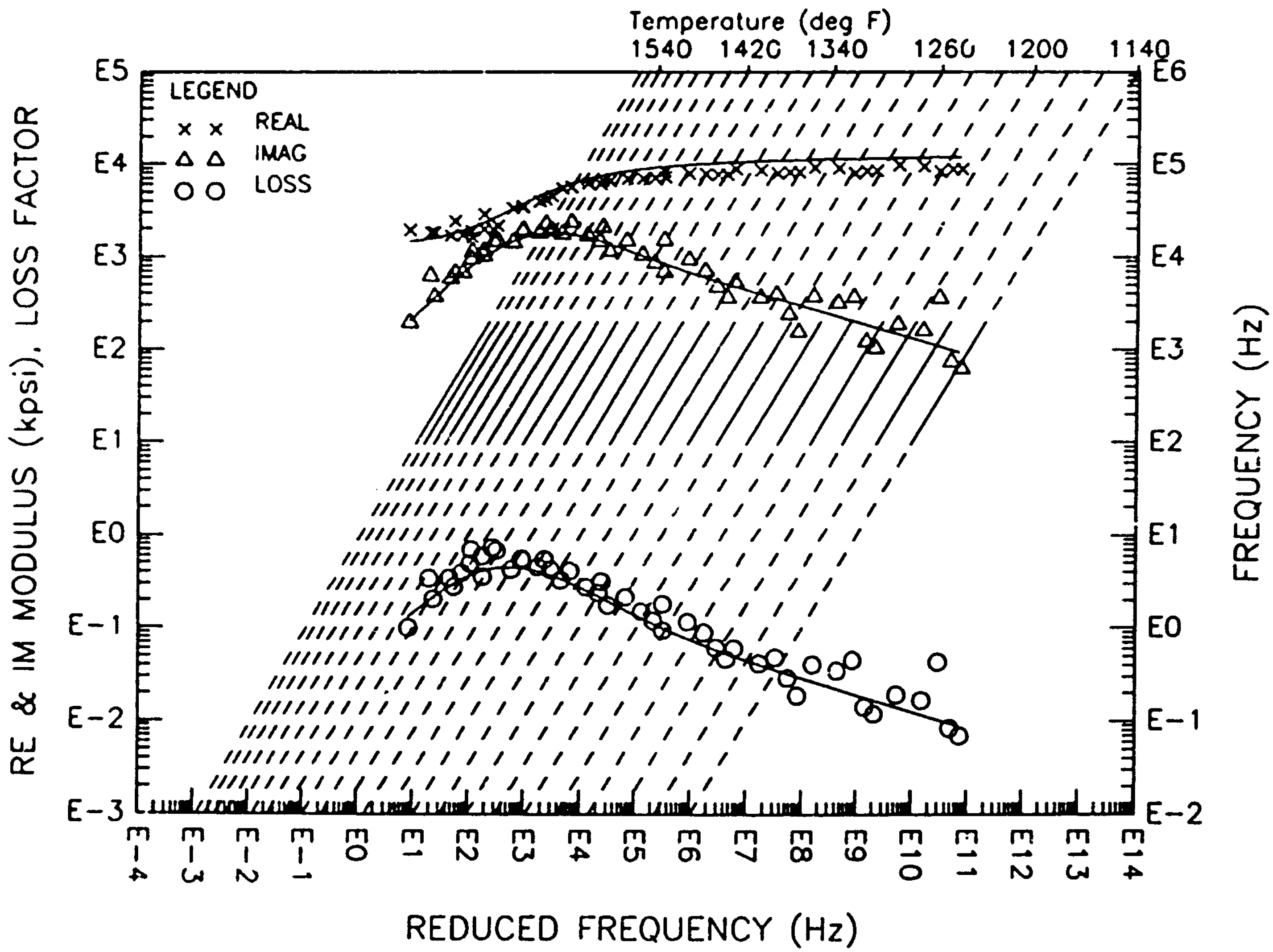
		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.8784E-02	0.3117	0.4453	0.3117	0.1317
MODULUS	MPA	0.8167E+05	0.3975E+05	0.2043E+05	0.1253E+05	0.1003E+05
	PSI	0.1184E+08	0.5766E+07	0.2963E+07	0.1818E+07	0.1455E+07
10.HZ	DEG K		995.0	1024.	1052.	
	DEG C		701.9	730.9	758.9	
	DEG F		1295.	1348.	1398.	
100.HZ	DEG K		1022.	1056.	1093.	
	DEG C		728.9	762.9	799.9	
	DEG F		1344.	1405.	1472.	
1000.HZ	DEG K		1055.	1097.	1150.	
	DEG C		761.9	803.9	856.9	
	DEG F		1403.	1479.	1574.	

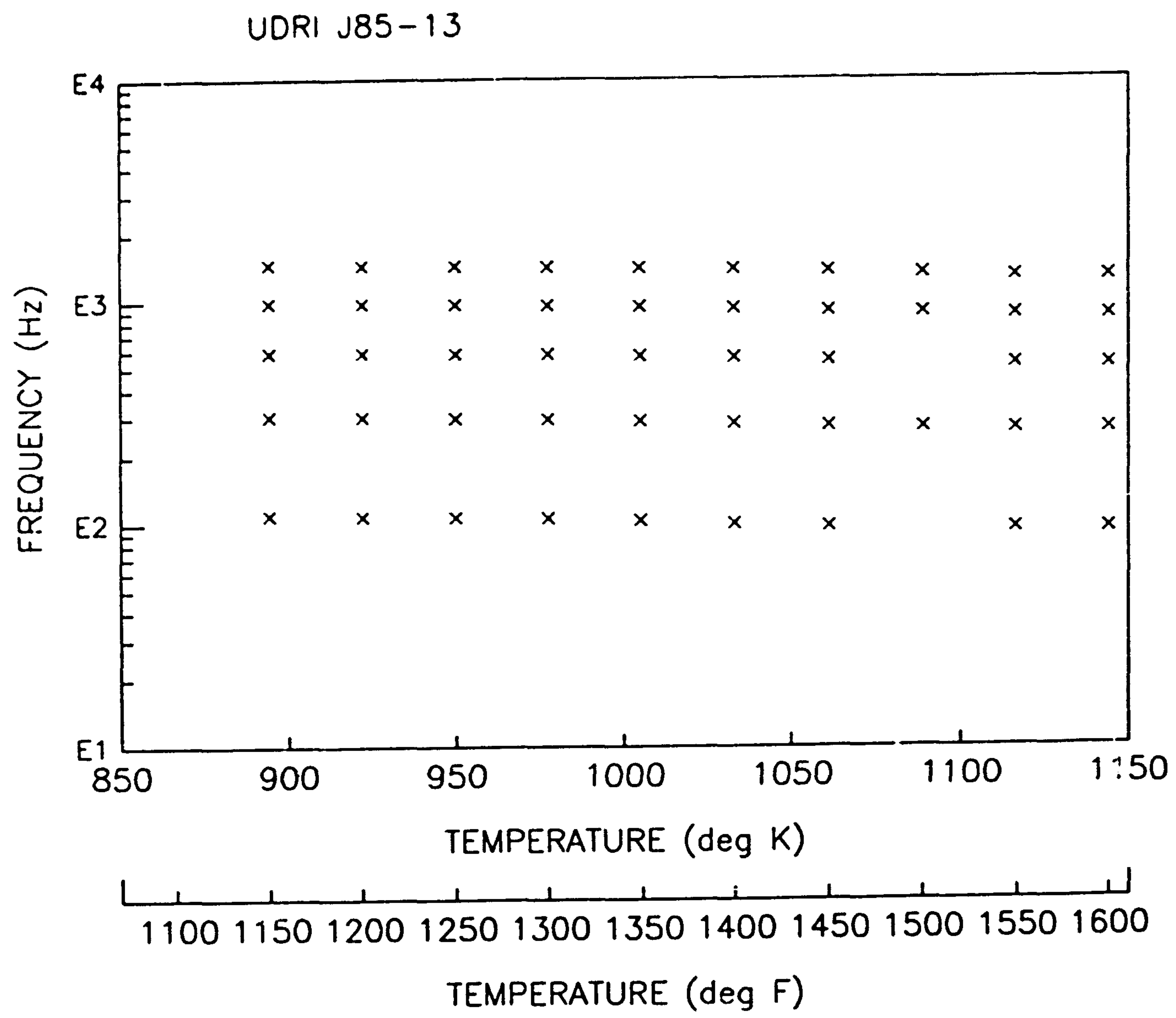


UDRI J85-13
YOUNG'S
Temperature (deg K)
1080
1020
980
950
920
890
LEGEND
× × REAL
Δ Δ IMAG
O O LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)
E5
E4
E3
E2
E1
E0
E−1
E−2
E−3
E6
E−4
E14

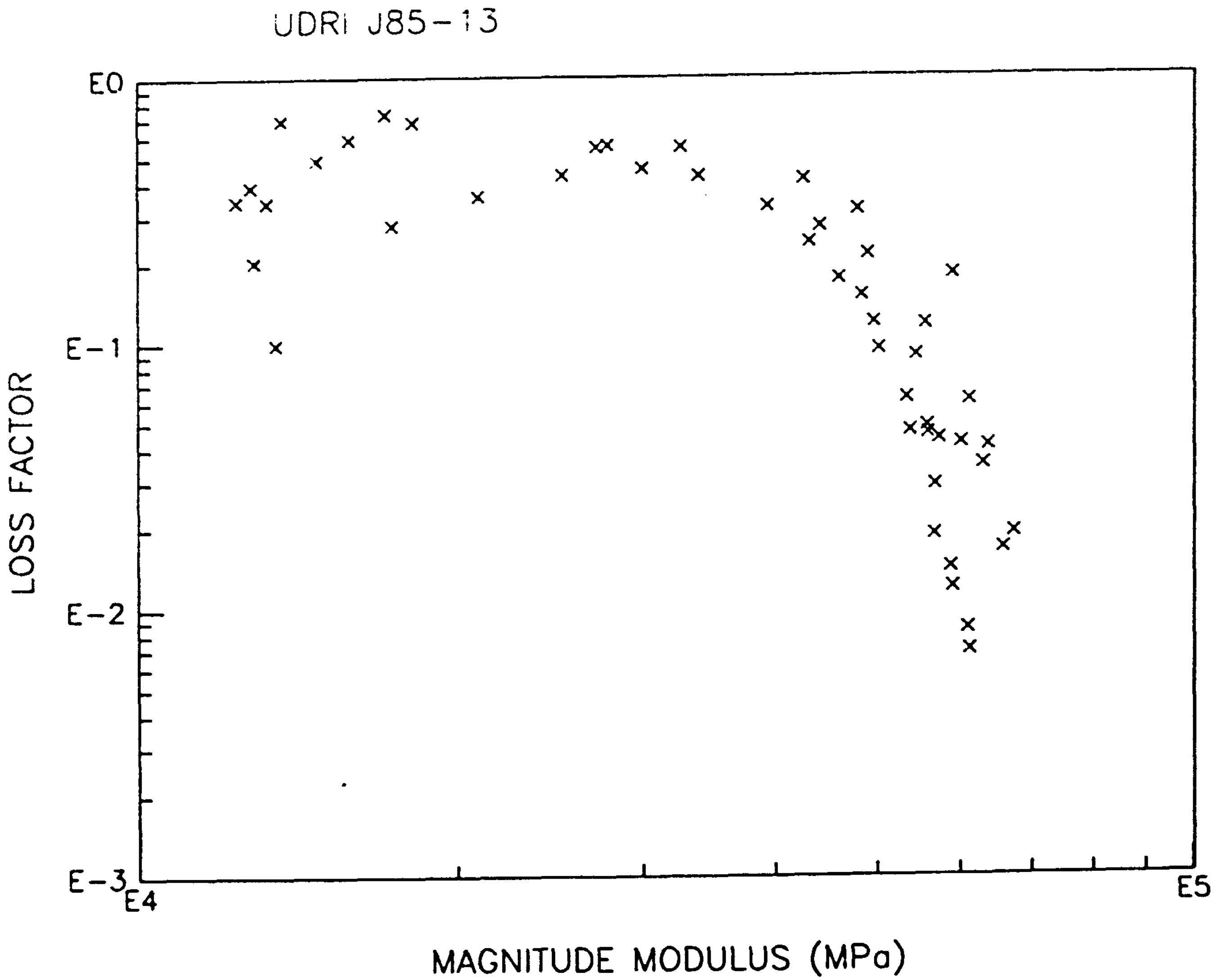
UDRI J85-13

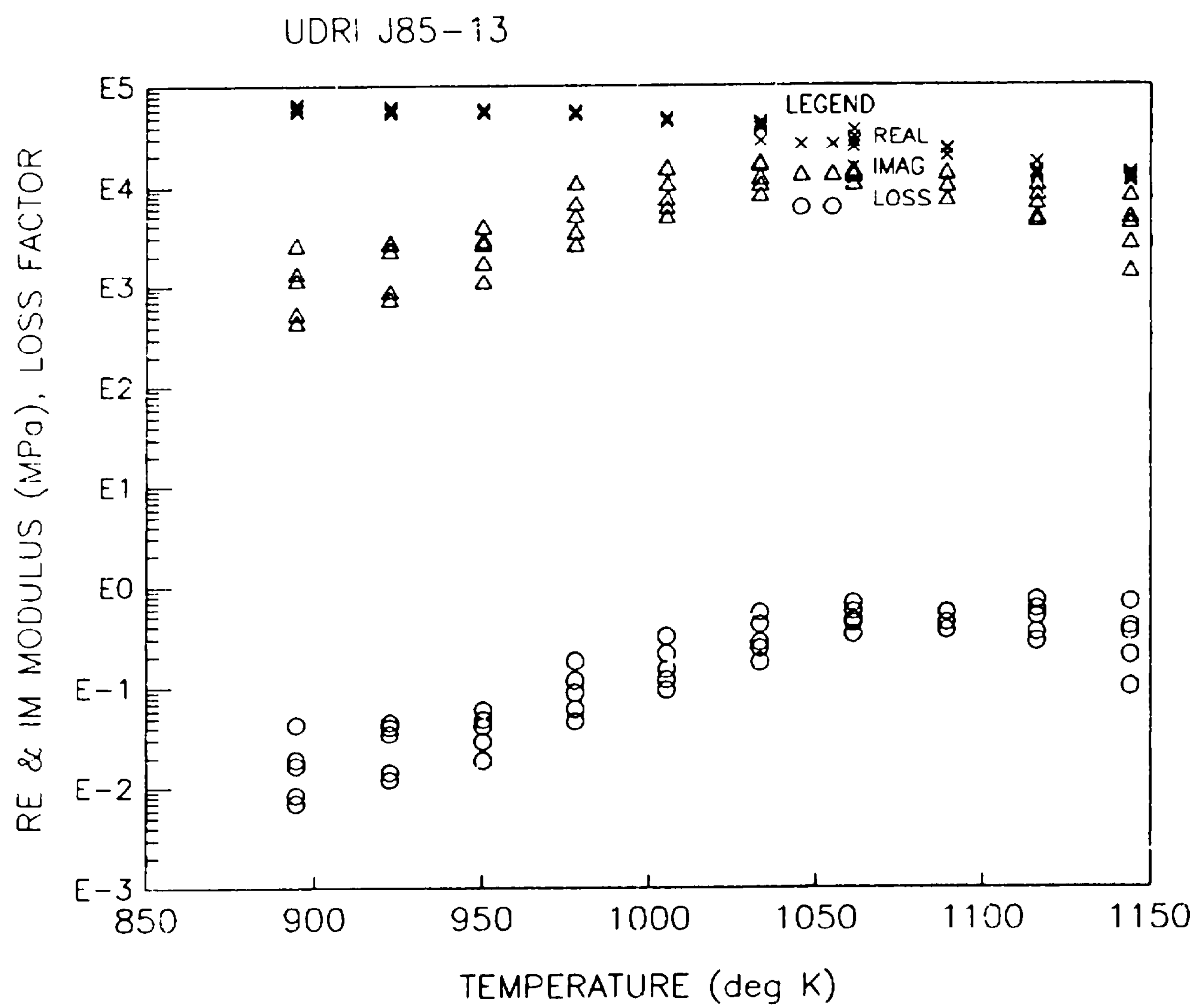
YOUNG'S



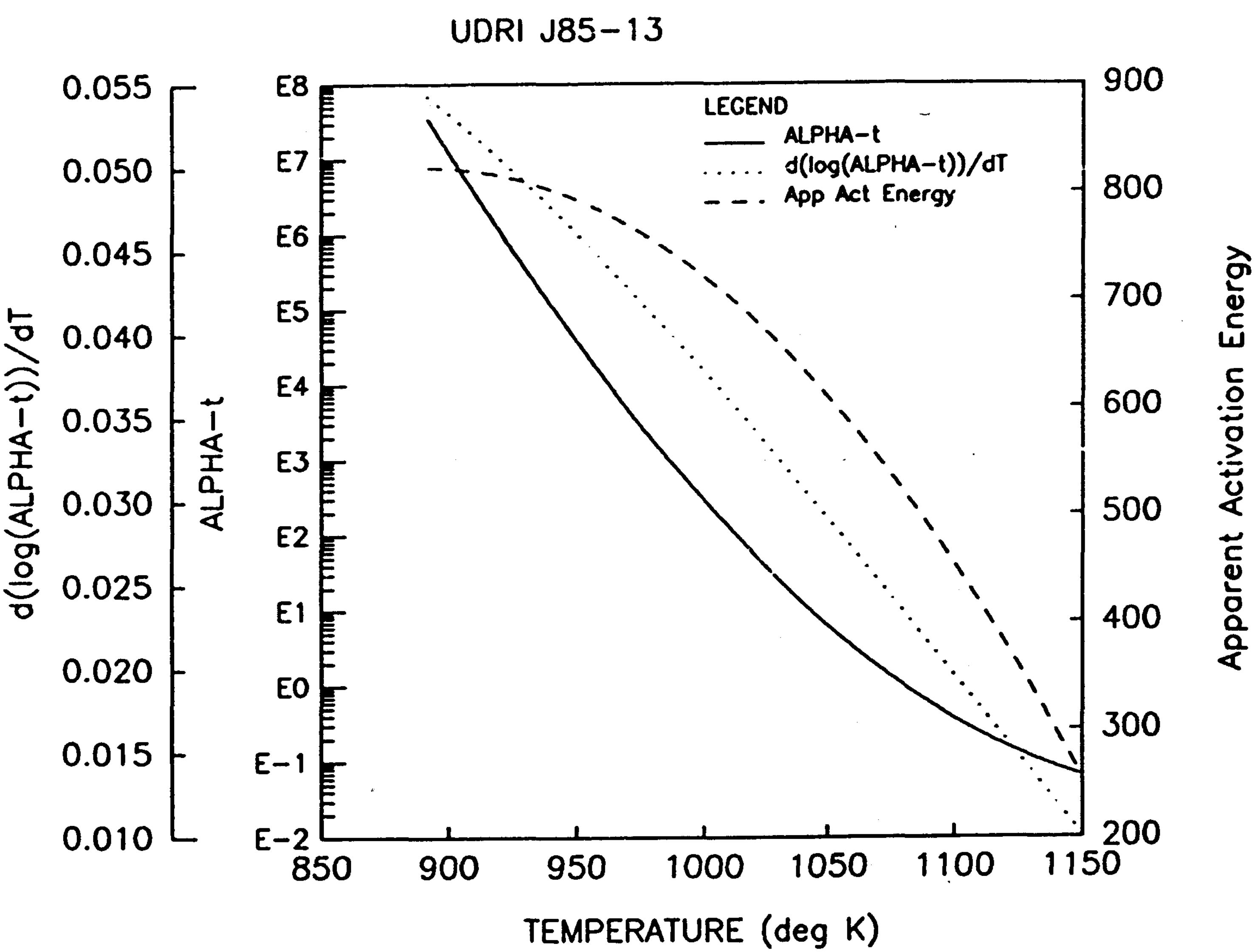


UDRI J85-13
FREQUENCY (Hz)
E4
E3
E2
E1
850
900
950
1000
1050
1100
1150
TEMPERATURE (deg K)
1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600
TEMPERATURE (deg F)


UDRI J85-13
E0
E-1
E-2
E-3
LOSS FACTOR
E4
E5
MAGNITUDE MODULUS (MPa)



UDRI J85-13
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
850
900
950
1000
1050
1100
1150
TEMPERATURE (deg K)


UDRI J85-13
LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
ALPHA-t
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
Apparent Activation Energy
900
800
700
600
500
400
300
200
850
900
950
1000
1050
1100
1150
TEMPERATURE (deg K)

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	1060.	890.0	1150.	0.2334E-01	0.5443E-01	0.1010E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	9052.	0.7500E+05	2890.	0.6277	0.7851	0.1922

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
1061.	96.80	0.1500E+05	0.6808	0.1021E+05
1061.	274.7	0.2430E+05	0.5556	0.1350E+05
1061.	543.3	0.2730E+05	0.4529	0.1236E+05
1061.	906.5	0.3120E+05	0.4240	0.1323E+05
1061.	1369.	0.3740E+05	0.3260	0.1219E+05
1033.	1395.	0.4530E+05	0.1743	7896.
1033.	928.9	0.4200E+05	0.2387	0.1003E+05
1033.	558.6	0.4260E+05	0.2735	0.1165E+05
1033.	283.9	0.3940E+05	0.4102	0.1616E+05
1033.	99.90	0.2860E+05	0.5445	0.1557E+05
1005.	103.4	0.4570E+05	0.3142	0.1436E+05
1005.	290.0	0.4790E+05	0.2134	0.1022E+05
1005.	569.1	0.4780E+05	0.1502	7180.
1005.	945.6	0.4930E+05	0.1185	5857.
1005.	1413.	0.4990E+05	0.9410E-01	4696.
977.6	1430.	0.5370E+05	0.4640E-01	2492.
977.6	956.9	0.5320E+05	0.6160E-01	3277.
977.6	578.2	0.5420E+05	0.8910E-01	4829.
977.6	294.9	0.5520E+05	0.1165	6431.
977.6	105.9	0.5800E+05	0.1798	0.1043E+05
949.9	106.9	0.6100E+05	0.6040E-01	3684.
949.9	298.8	0.6000E+05	0.4170E-01	2502.
949.9	582.7	0.5570E+05	0.4830E-01	2690.
949.9	967.8	0.5670E+05	0.2900E-01	1644.
949.9	1444.	0.5660E+05	0.1880E-01	1064.
922.1	1456.	0.5890E+05	0.1200E-01	706.8
922.1	976.0	0.5870E+05	0.1420E-01	833.5
922.1	586.4	0.5580E+05	0.4520E-01	2522.
922.1	301.8	0.6290E+05	0.3470E-01	2183.
922.1	107.9	0.6360E+05	0.4060E-01	2582.
894.2	109.1	0.6720E+05	0.1920E-01	1290.
894.2	304.7	0.6570E+05	0.1670E-01	1097.
894.2	590.6	0.5720E+05	0.4310E-01	2465.
894.2	984.9	0.6090E+05	0.8400E-02	511.6
894.2	1469.	0.6110E+05	0.7000E-02	427.7
1144.	1280.	0.1120E+05	0.6969	7805.
1144.	856.1	0.1190E+05	0.3900	4641.
1144.	516.1	0.1170E+05	0.3440	4025.
1144.	263.4	0.1260E+05	0.2034	2563.
1144.	94.00	0.1340E+05	0.1002	1343.

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
1116.	94.70	0.1250E+05	0.3413	4266.
1116.	265.4	0.1670E+05	0.2779	4641.
1116.	521.7	0.1320E+05	0.4932	6510.
1116.	865.7	0.1360E+05	0.5896	8019.
1116.	1296.	0.1380E+05	0.7298	0.1007E+05
1089.	1330.	0.2380E+05	0.5443	0.1295E+05
1089.	887.4	0.2310E+05	0.4261	9843.
1089.	270.3	0.1970E+05	0.3563	7019.

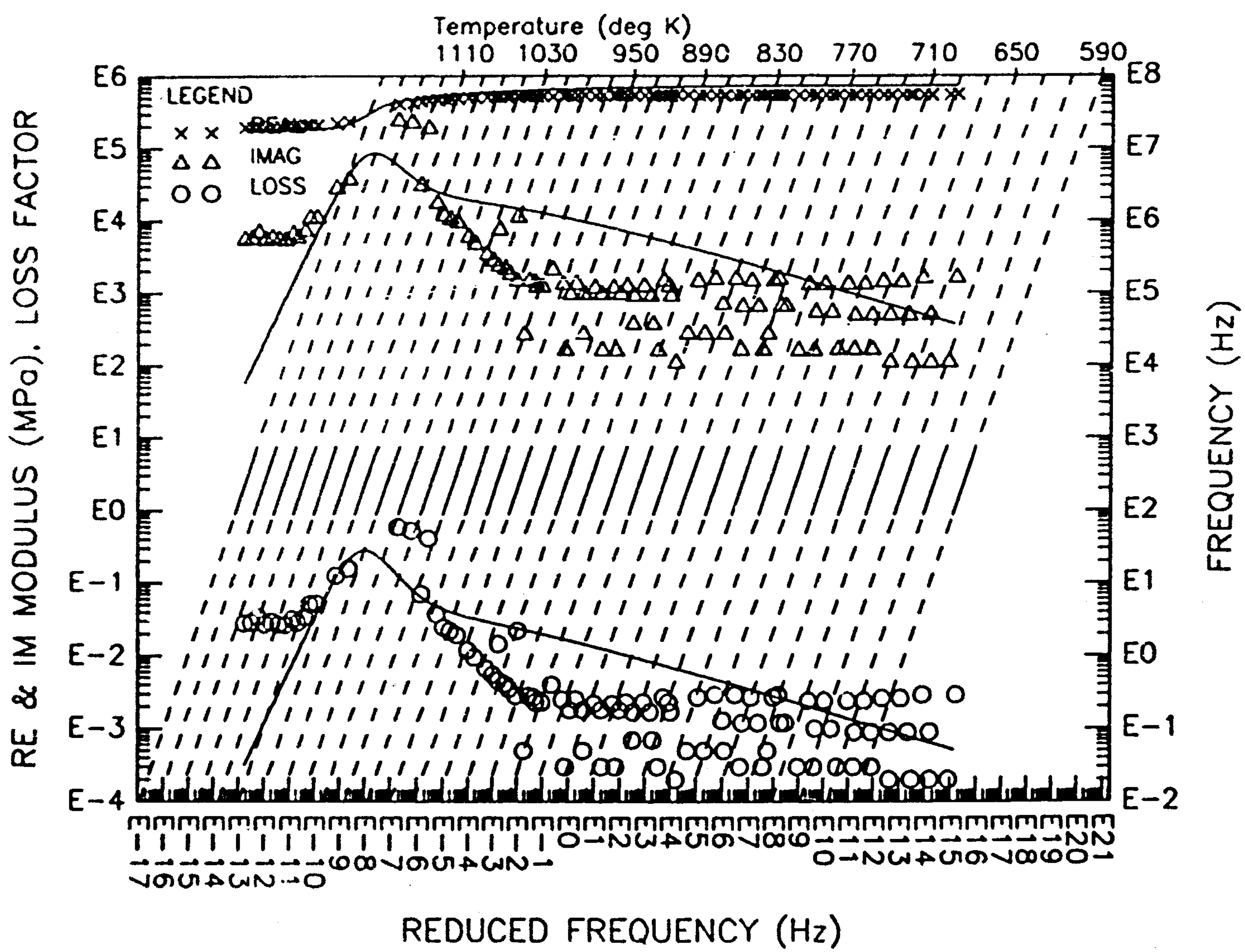
S-13C

YOUNG'S

		GLASSY (IE. MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7*DMAX	PEAK DMAX	RUBBERY SKIRT 0.7*DMAX	RUBBERY (IE. MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.5060E-03	0.1442	0.2059	0.1442	0.3157E-03
MODULUS	MPA	0.7277E+06	0.4334E+06	0.2802E+06	0.2001E+06	0.1800E+06
	PSI	0.1055E+09	0.6286E+08	0.4063E+08	0.2902E+08	0.2611E+08
10.HZ	DEG K		1012.	1039.	1062.	
	DEG C		718.9	745.9	768.9	
	DEG F		1326.	1375.	1416.	
100.HZ	DEG K		1034.	1062.	1085.	
	DEG C		740.9	768.9	791.9	
	DEG F		1366.	1416.	1457.	
1000.HZ	DEG K		1057.	1085.	1108.	
	DEG C		763.9	791.9	814.9	
	DEG F		1407.	1457.	1499.	

S-13C

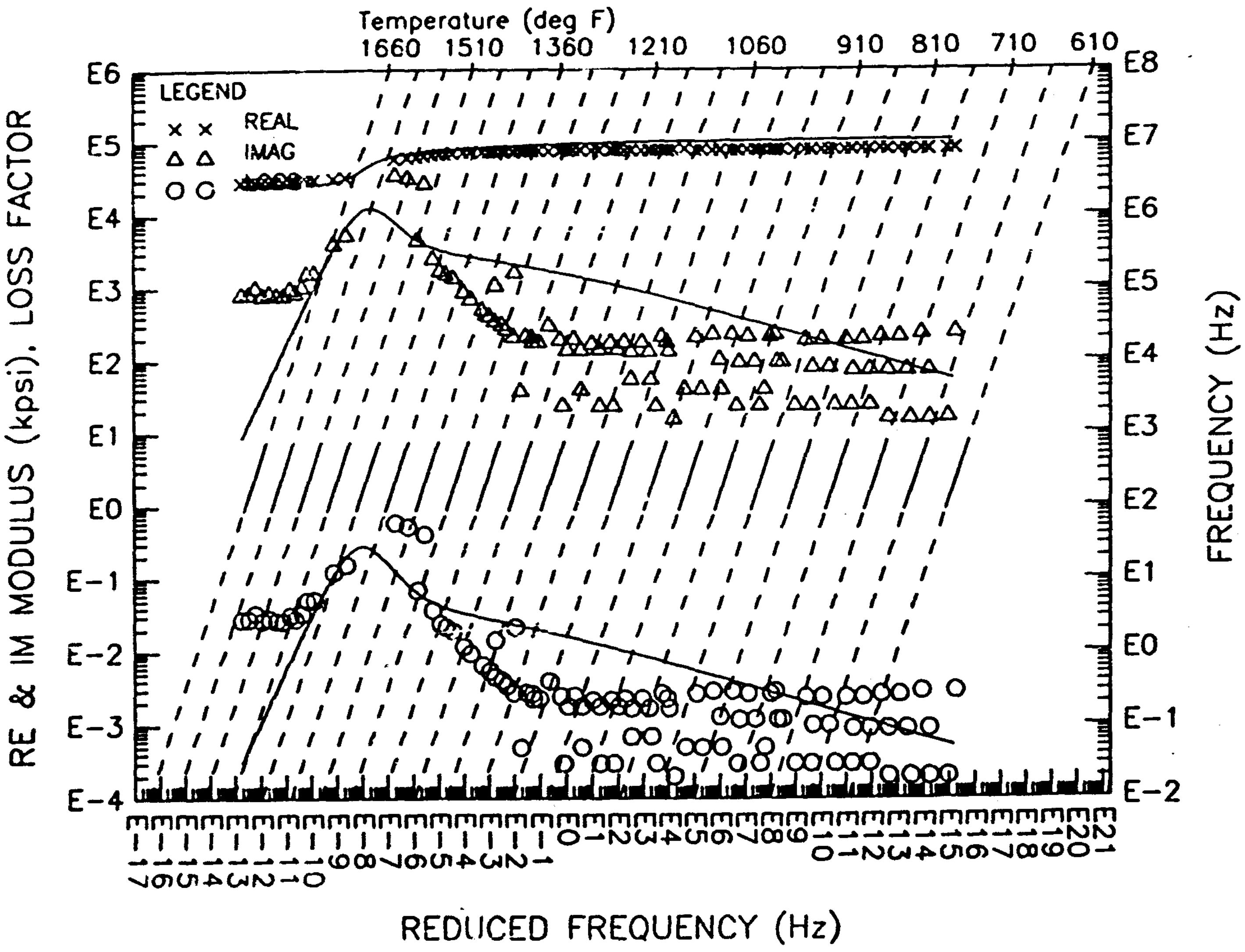
YOUNG'S



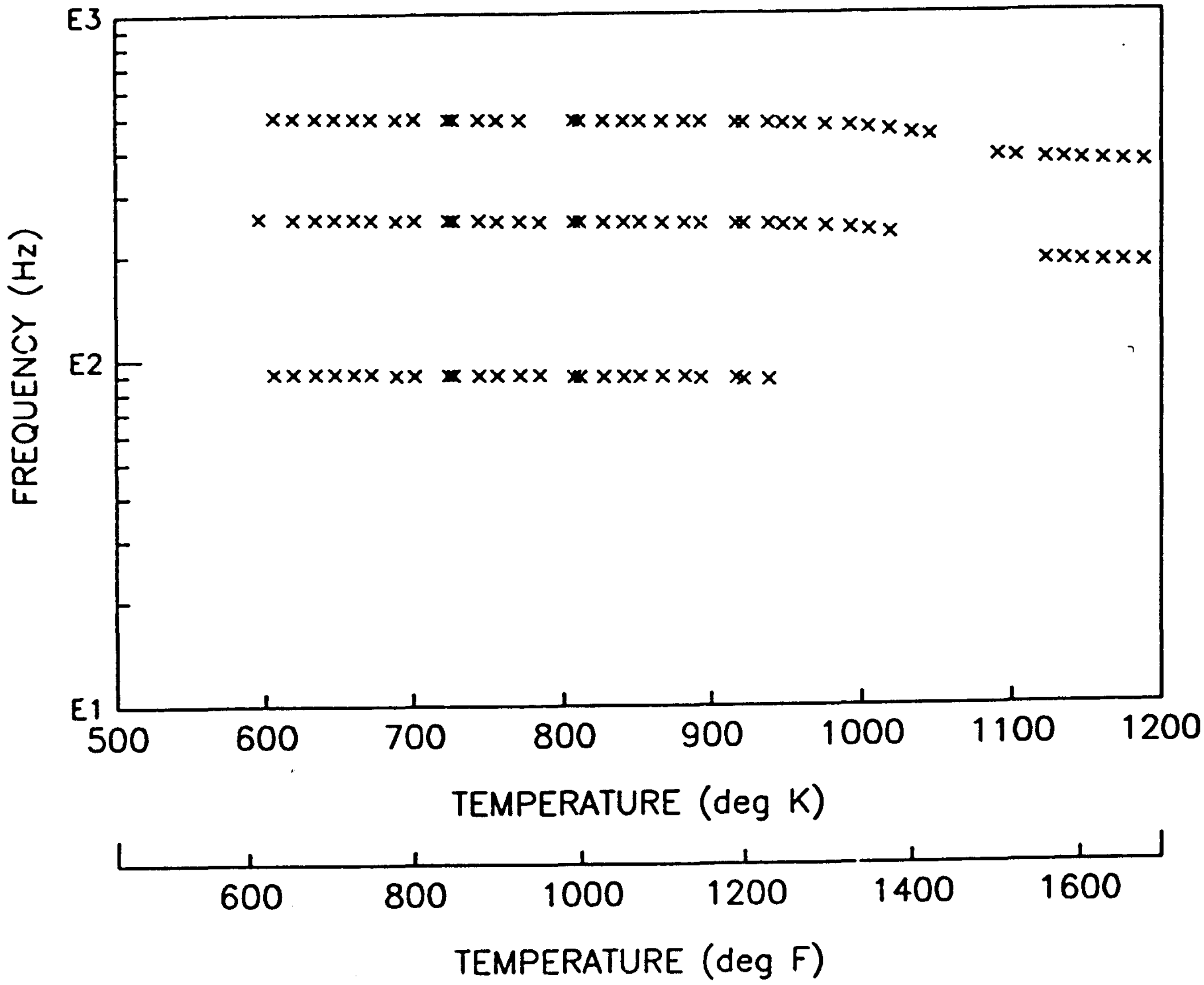
Temperature (deg K)
1110 1030 950 890 830 770 710 650 590
LEGEND
× × RE
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E6 E5 E4 E3 E2 E1 E0 E−1 E−2 E−3 E−4
E8 E7 E6 E5 E4 E3 E2 E1 E0 E−1 E−2
FREQUENCY (Hz)
E−17 E−16 E−15 E−14 E−13 E−12 E−11 E−10 E−9 E−8 E−7 E−6 E−5 E−4 E−3 E−2 E−1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21
REDUCED FREQUENCY (Hz)

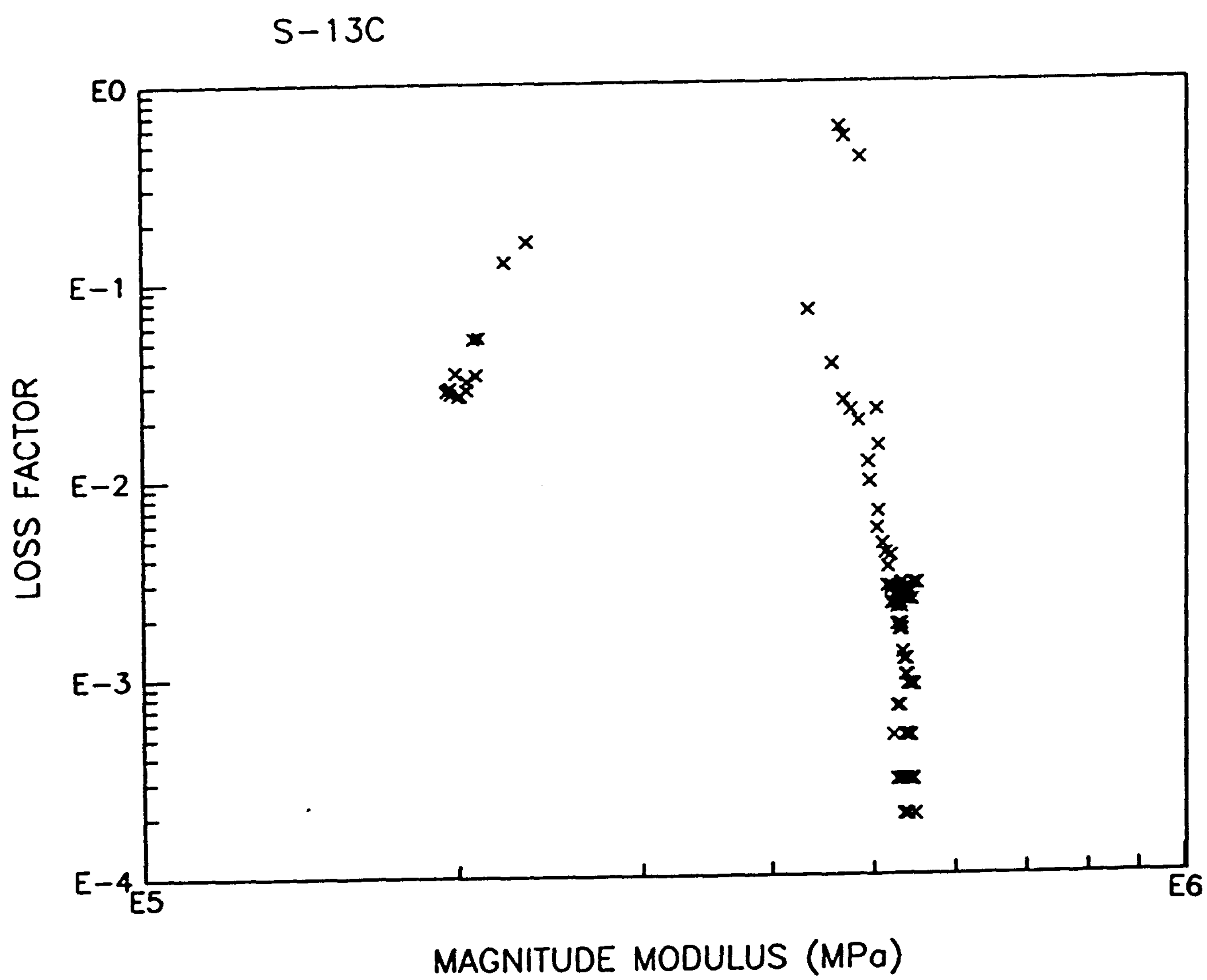
S-13C

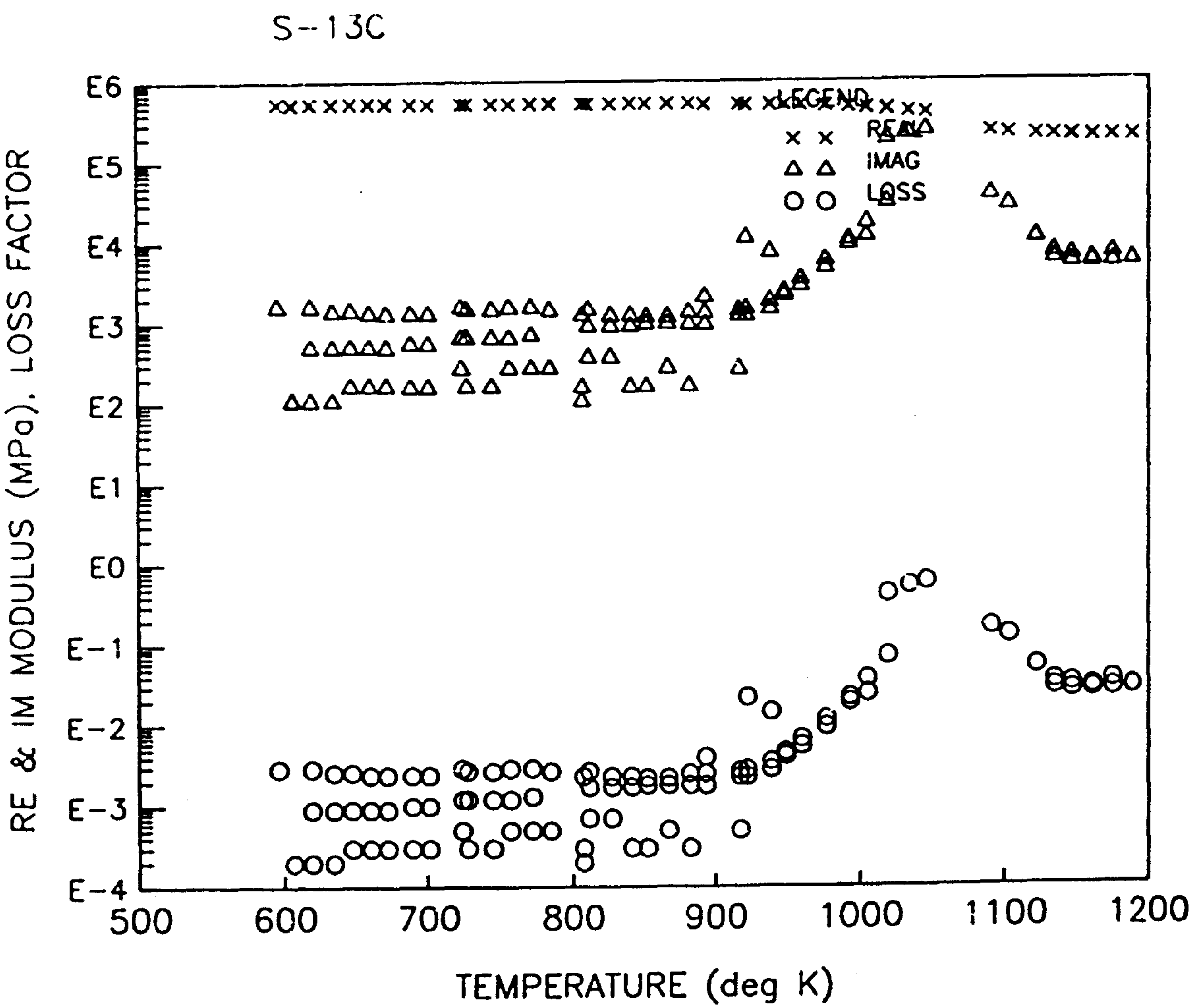
YOUNG'S

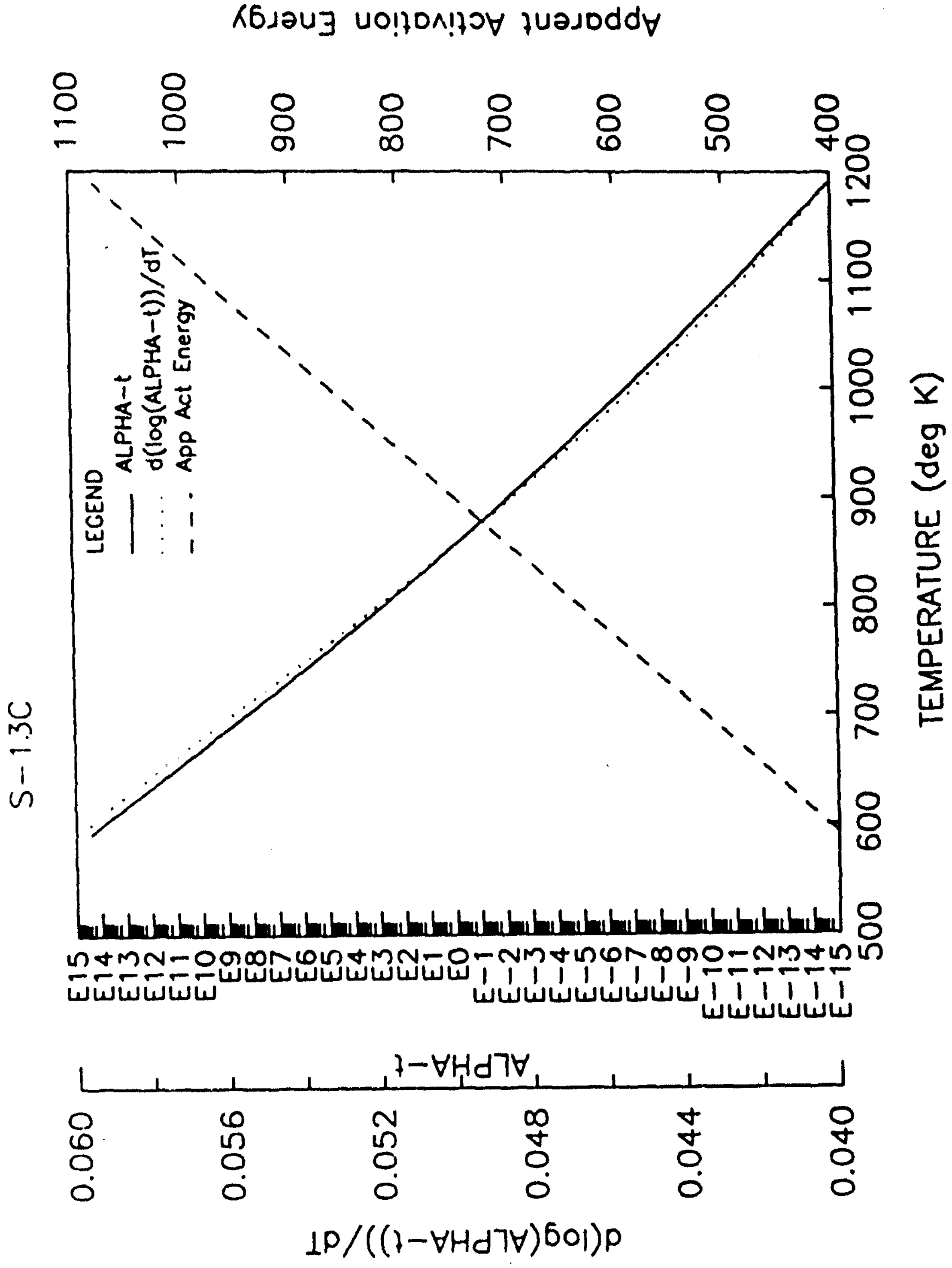

Temperature (deg F)
1660 1510 1360 1210 1060 910 810 710 610
LEGEND
× × REAL
Δ Δ IMAG
O O
RE & IM MODULUS (kpsi), LOSS FACTOR
E6 E5 E4 E3 E2 E1 E0 E-1 E-2 E-3 E-4
FREQUENCY (Hz)
E8 E7 E6 E5 E4 E3 E2 E1 E0 E-1 E-2
E-17 E-16 E-15 E-14 E-13 E-12 E-11 E-10 E-9 E-8 E-7 E-6 E-5 E-4 E-3 E-2 E-1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21
REDUCED FREQUENCY (Hz)

S-13C


E3
E2
E1
FREQUENCY (Hz)
500
600
700
800
900
1000
1100
1200
TEMPERATURE (deg K)
600
800
1000
1200
1400
1600
TEMPERATURE (deg F)


S-13C
LOSS FACTOR
E0
E-1
E-2
E-3
E-4
E5
E6
MAGNITUDE MODULUS (MPa)


S-13C
LEGEND
REAL
IMAG
LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
500
600
700
800
900
1000
1100
1200
TEMPERATURE (deg K)



S−1.3C
LEGEND
ALPHA−t
d(log(ALPHA−t))/dT
App Act Energy
TEMPERATURE (deg K)
500
600
700
800
900
1000
1100
1200
ALPHA−t
d(log(ALPHA−t))/dT
0.040
0.044
0.048
0.052
0.056
0.060
Apparent Activation Energy
400
500
600
700
800
900
1000
1100
E15
E−15

S-13C YOUNG'S

ALFA-T MODEL

NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
4	6	855.0	590.0	1190.	0.5000E-01	0.6000E-01	0.4000E-01

COMPLEX MODULUS MODEL

NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	0.1800E+06	0.5500E+06	0.1000E-06	0.7000	1.000	0.1000

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
605.7	91.00	0.5340E+06	0.2000E-03	106.8
595.6	257.0	0.5500E+06	0.2900E-02	1595.
605.7	503.0	0.5471E+06	0.2000E-03	109.4
618.4	91.00	0.5360E+06	0.2000E-03	107.2
618.4	256.0	0.5450E+06	0.2900E-02	1581.
618.4	502.0	0.5460E+06	0.9000E-03	491.4
633.4	91.00	0.5389E+06	0.2000E-03	107.8
633.4	255.0	0.5400E+06	0.2600E-02	1404.
633.4	501.0	0.5440E+06	0.9000E-03	489.6
646.3	91.00	0.5410E+06	0.3000E-03	162.3
646.3	255.0	0.5420E+06	0.2600E-02	1409.
646.3	500.0	0.5430E+06	0.9000E-03	488.7
659.1	91.00	0.5430E+06	0.3000E-03	162.9
659.1	255.0	0.5440E+06	0.2400E-02	1306.
659.1	499.0	0.5410E+06	0.9000E-03	486.9
671.2	91.00	0.5450E+06	0.3000E-03	163.5
671.2	254.0	0.5389E+06	0.2400E-02	1293.
671.2	498.0	0.5389E+06	0.9000E-03	485.0
688.5	90.00	0.5270E+06	0.3000E-03	158.1
688.5	253.0	0.5340E+06	0.2400E-02	1282.
688.5	497.0	0.5381E+06	0.1000E-02	538.1
700.7	90.00	0.5289E+06	0.3000E-03	158.7
700.7	253.0	0.5360E+06	0.2400E-02	1286.
700.7	496.0	0.5360E+06	0.1000E-02	536.0
723.4	90.00	0.5360E+06	0.5000E-03	268.0
723.4	252.0	0.5320E+06	0.2900E-02	1543.
723.4	495.0	0.5360E+06	0.1200E-02	643.2
727.0	90.00	0.5330E+06	0.3000E-03	159.9
727.0	252.0	0.5330E+06	0.2700E-02	1439.
727.0	495.0	0.5371E+06	0.1200E-02	644.5
744.0	90.00	0.5360E+06	0.3000E-03	160.8
744.0	252.0	0.5360E+06	0.2700E-02	1447.
744.0	494.0	0.5360E+06	0.1200E-02	643.2
756.0	90.00	0.5381E+06	0.5000E-03	269.1
756.0	251.0	0.5299E+06	0.2900E-02	1537.
756.0	493.0	0.5340E+06	0.1200E-02	640.8
771.0	90.00	0.5400E+06	0.5000E-03	270.0
771.0	251.0	0.5330E+06	0.2900E-02	1546.
771.0	492.0	0.5330E+06	0.1300E-02	692.9
784.0	90.00	0.5420E+06	0.5000E-03	271.0

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
784.0	250.0	0.5281E+06	0.2700E-02	1426.
807.0	89.00	0.5260E+06	0.3000E-03	157.8
807.0	250.0	0.5310E+06	0.2300E-02	1221.
807.0	491.0	0.5350E+06	0.2000E-03	107.0
811.0	89.00	0.5260E+06	0.7000E-03	368.2
811.0	250.0	0.5320E+06	0.2700E-02	1436.
811.0	490.0	0.5320E+06	0.1700E-02	904.4
827.0	89.00	0.5289E+06	0.7000E-03	370.2
827.0	249.0	0.5270E+06	0.2300E-02	1212.
827.0	489.0	0.5299E+06	0.1700E-02	900.8
841.0	89.00	0.5310E+06	0.3000E-03	159.3
841.0	249.0	0.5289E+06	0.2300E-02	1216.
841.0	488.0	0.5289E+06	0.1700E-02	899.1
852.0	89.00	0.5320E+06	0.3000E-03	159.6
852.0	249.0	0.5310E+06	0.2200E-02	1168.
852.0	488.0	0.5310E+06	0.1800E-02	955.8
867.0	89.00	0.5350E+06	0.5000E-03	267.5
867.0	248.0	0.5260E+06	0.2200E-02	1157.
867.0	487.0	0.5289E+06	0.1800E-02	952.0
882.0	89.00	0.5371E+06	0.3000E-03	161.1
882.0	248.0	0.5281E+06	0.2500E-02	1320.
882.0	486.0	0.5281E+06	0.1800E-02	950.6
893.0	88.00	0.5191E+06	0.4000E-02	2076.
893.0	247.0	0.5230E+06	0.2500E-02	1308.
893.0	485.0	0.5260E+06	0.1800E-02	946.8
917.0	88.00	0.5220E+06	0.5000E-03	261.0
917.0	246.0	0.5199E+06	0.2700E-02	1404.
917.0	483.0	0.5220E+06	0.2300E-02	1201.
922.0	87.00	0.5040E+06	0.2200E-01	0.1109E+05
922.0	246.0	0.5199E+06	0.2800E-02	1456.
922.0	482.0	0.5199E+06	0.2300E-02	1196.
939.0	87.00	0.5060E+06	0.1450E-01	7337.
939.0	245.0	0.5160E+06	0.3500E-02	1806.
939.0	480.0	0.5150E+06	0.2800E-02	1442.
949.0	244.0	0.5099E+06	0.4600E-02	2346.
949.0	479.0	0.5130E+06	0.4100E-02	2103.
960.0	243.0	0.5050E+06	0.6700E-02	3384.
960.0	476.0	0.5040E+06	0.5500E-02	2772.
977.0	241.0	0.4940E+06	0.1190E-01	5879.
977.0	473.0	0.4960E+06	0.9500E-02	4712.
993.0	238.0	0.4760E+06	0.2190E-01	0.1042E+05
993.0	469.0	0.4840E+06	0.1920E-01	9293.
1005.	235.0	0.4570E+06	0.3730E-01	0.1705E+05
1005.	464.0	0.4690E+06	0.2450E-01	0.1149E+05
1019.	231.0	0.4331E+06	0.7000E-01	0.3032E+05
1019.	458.0	0.4500E+06	0.4137	0.1862E+06
1034.	447.0	0.4160E+06	0.5260	0.2188E+06
1046.	442.0	0.4010E+06	0.5904	0.2368E+06
1091.	384.0	0.2300E+06	0.1583	0.3641E+05
1103.	380.0	0.2200E+06	0.1256	0.2763E+05
1122.	191.0	0.2070E+06	0.5150E-01	0.1066E+05
1122.	375.0	0.2090E+06	0.5210E-01	0.1089E+05
1134.	190.0	0.2041E+06	0.2850E-01	5817.
1134.	374.0	0.2080E+06	0.3390E-01	7051.
1146.	189.0	0.2000E+06	0.2640E-01	5280.
1146.	372.0	0.2041E+06	0.3160E-01	6450.
1160.	188.0	0.1970E+06	0.2910E-01	5733.

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
1160.	370.0	0.2010E+06	0.2680E-01	5387.
1174.	188.0	0.1990E+06	0.3440E-01	6846.
1174.	368.0	0.1970E+06	0.2720E-01	5358.
1188.	187.0	0.1951E+06	0.2800E-01	5463.
1188.	367.0	0.1959E+06	0.2850E-01	5583.

SECTION 3

STRUCTURAL EPOXIES AND OTHER MATERIALS

This section contains modulus and loss factor data for structural epoxies, in Section 3.1, structural plastics in Section 3.2 and other materials in Section 3.2, all presented in the reduced temperature nomogram format. The Young's modulus in these nomograms is given in Newtons per meter squared (N/m^2). Section 3.3 contains damping data for composites and metals.

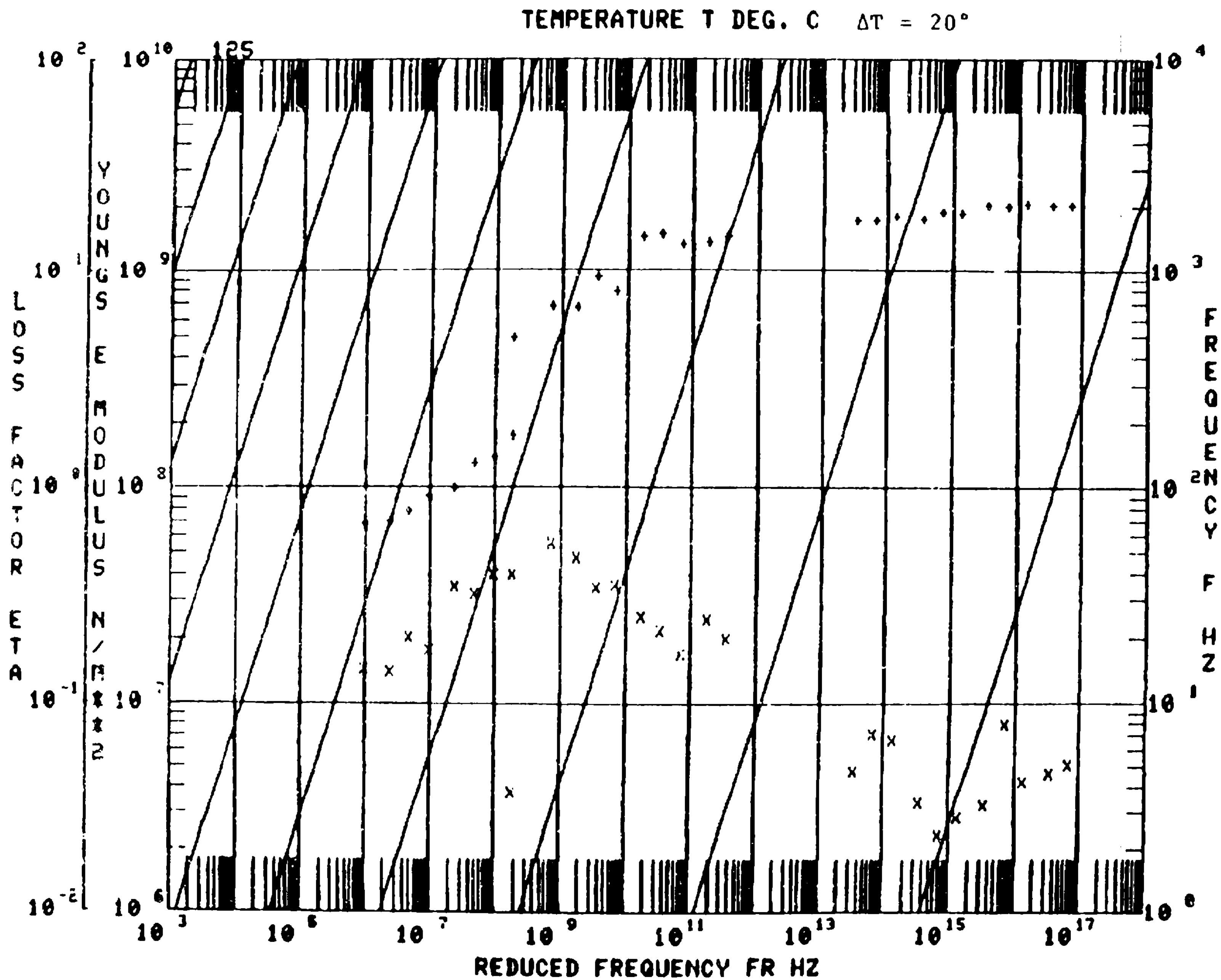
3.1 STRUCTURAL EPOXIES

The following data are for several structural epoxies. These data, listed in Table 2, were supplied by 3M. The data set does not cover all structural epoxies nor are the data complete. These data are given here simply to demonstrate to the designer trends that can be expected in various epoxies and that the loss factor in epoxies can vary substantially. It is very likely that some vibration problems could be controlled by choosing more highly damped epoxy.

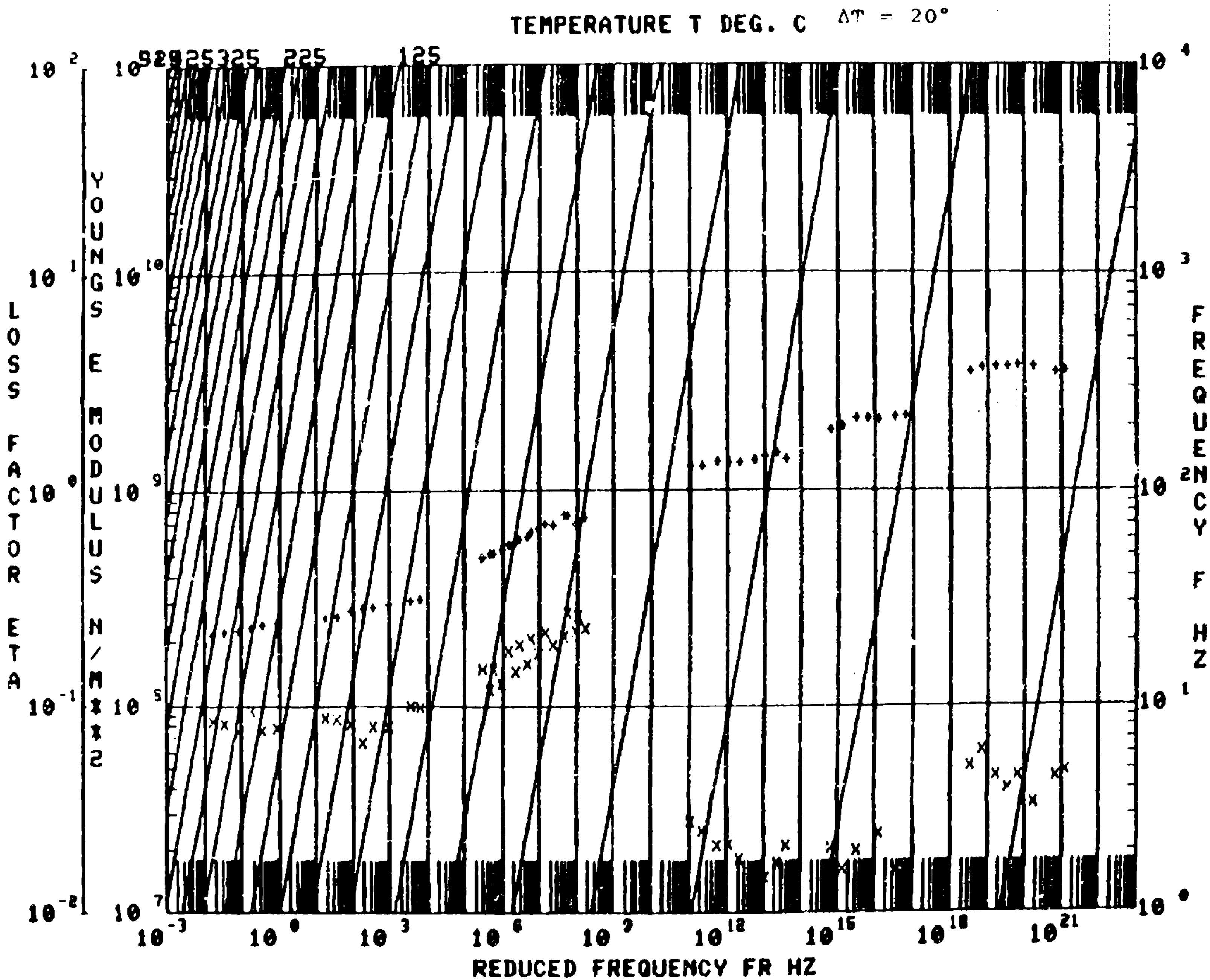
TABLE 2. LIST OF STRUCTURAL EPOXIES

Manufacturer	Material	Page
3M	AF-30	470
3M	AF-31	471
3M	AF-32	472
3M	AF-40	473
3M	AF-111	474
3M	AF-126	475
3M	EC-2216	476

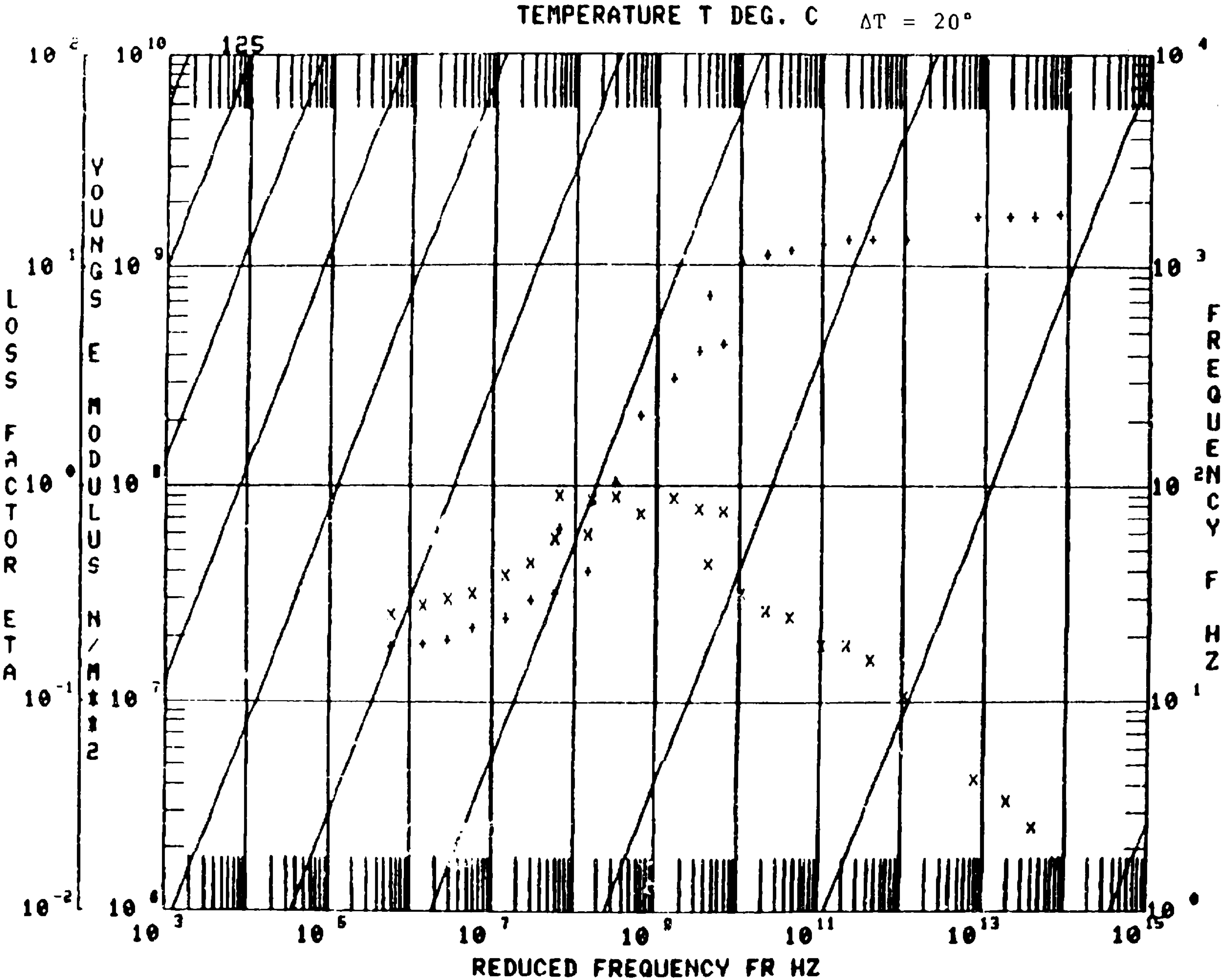
AF-30 Epoxy 3M



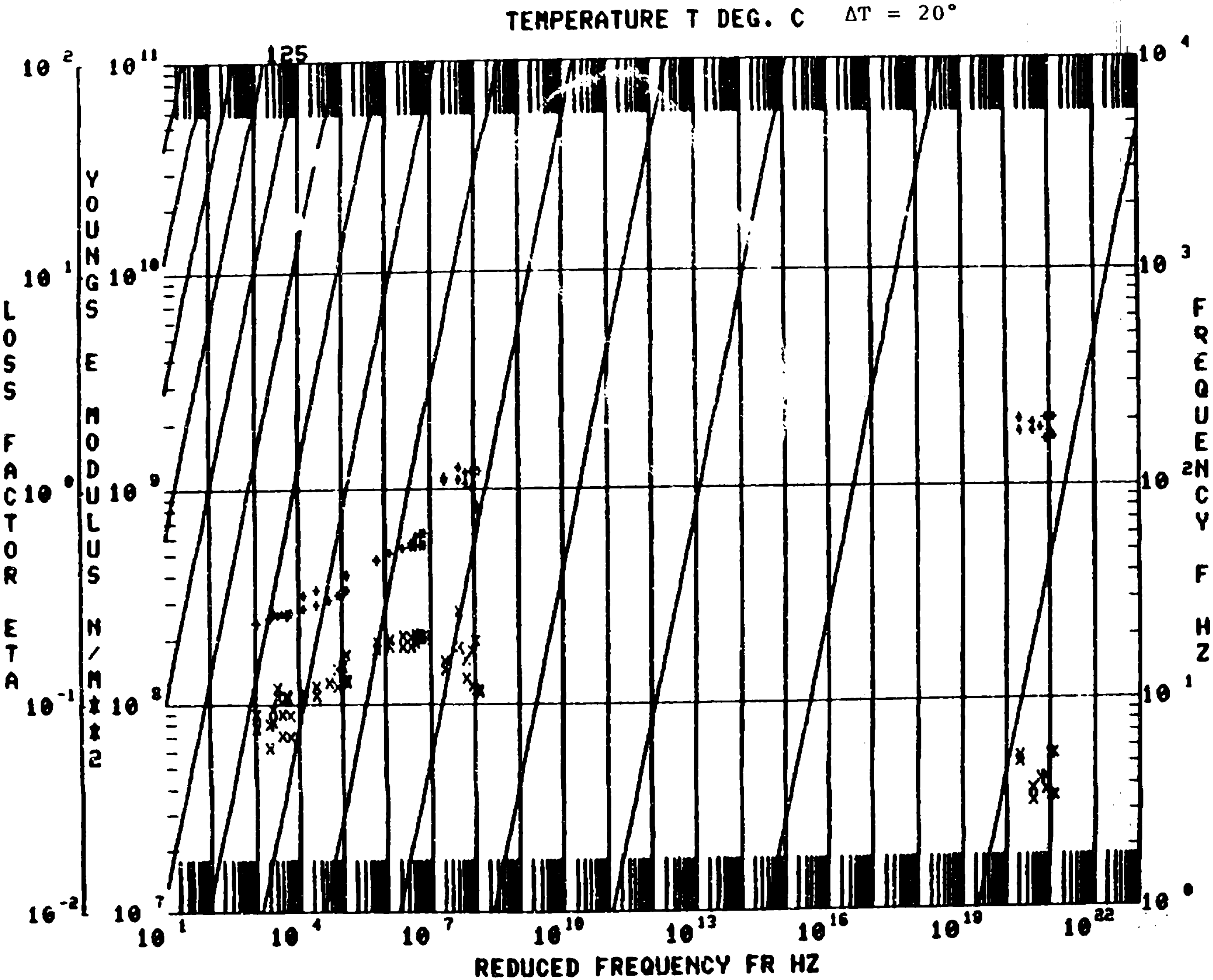
AF-31 Epoxy 3M



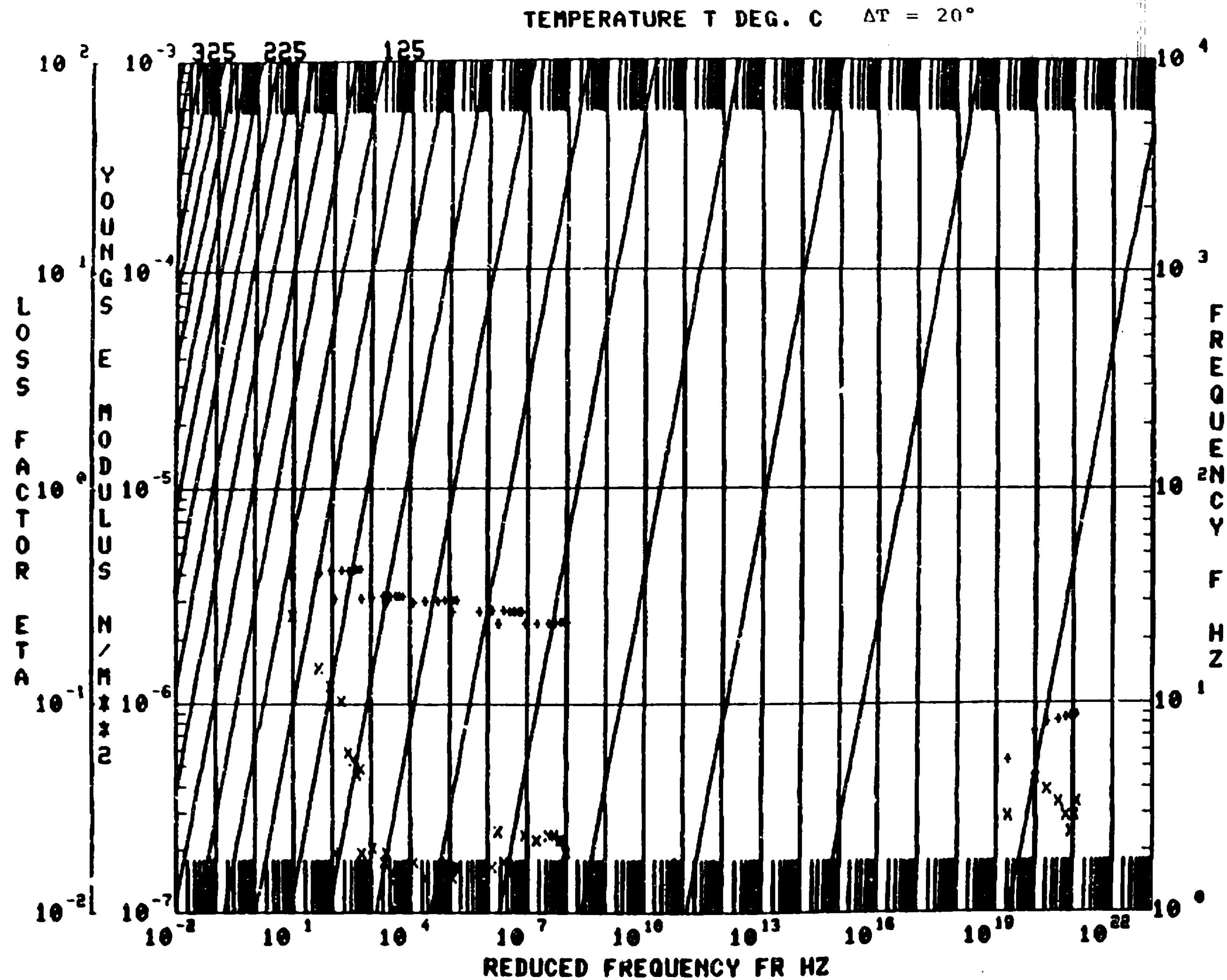
AF-32 Epoxy 3M



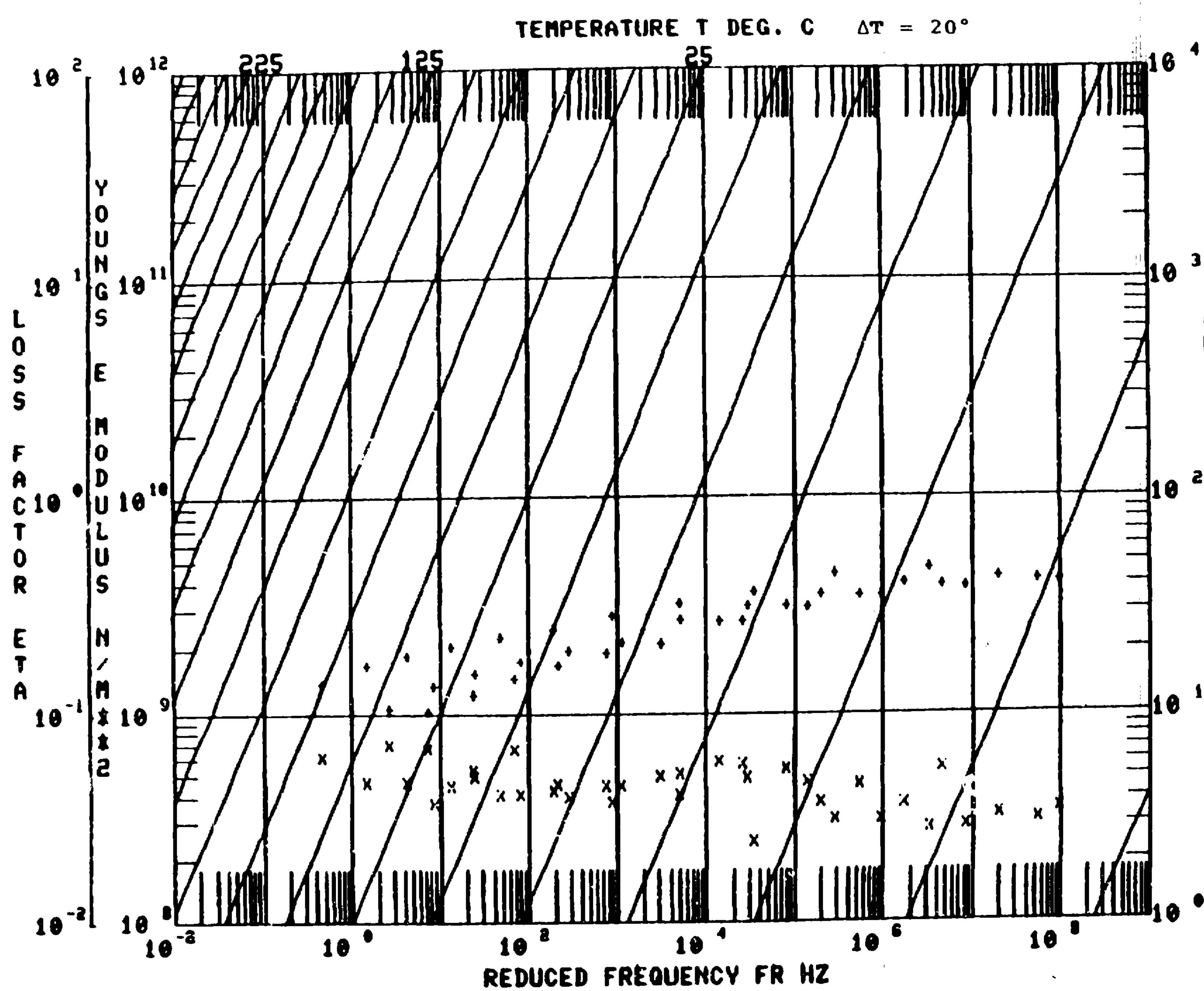
AF-40 Epoxy 3M



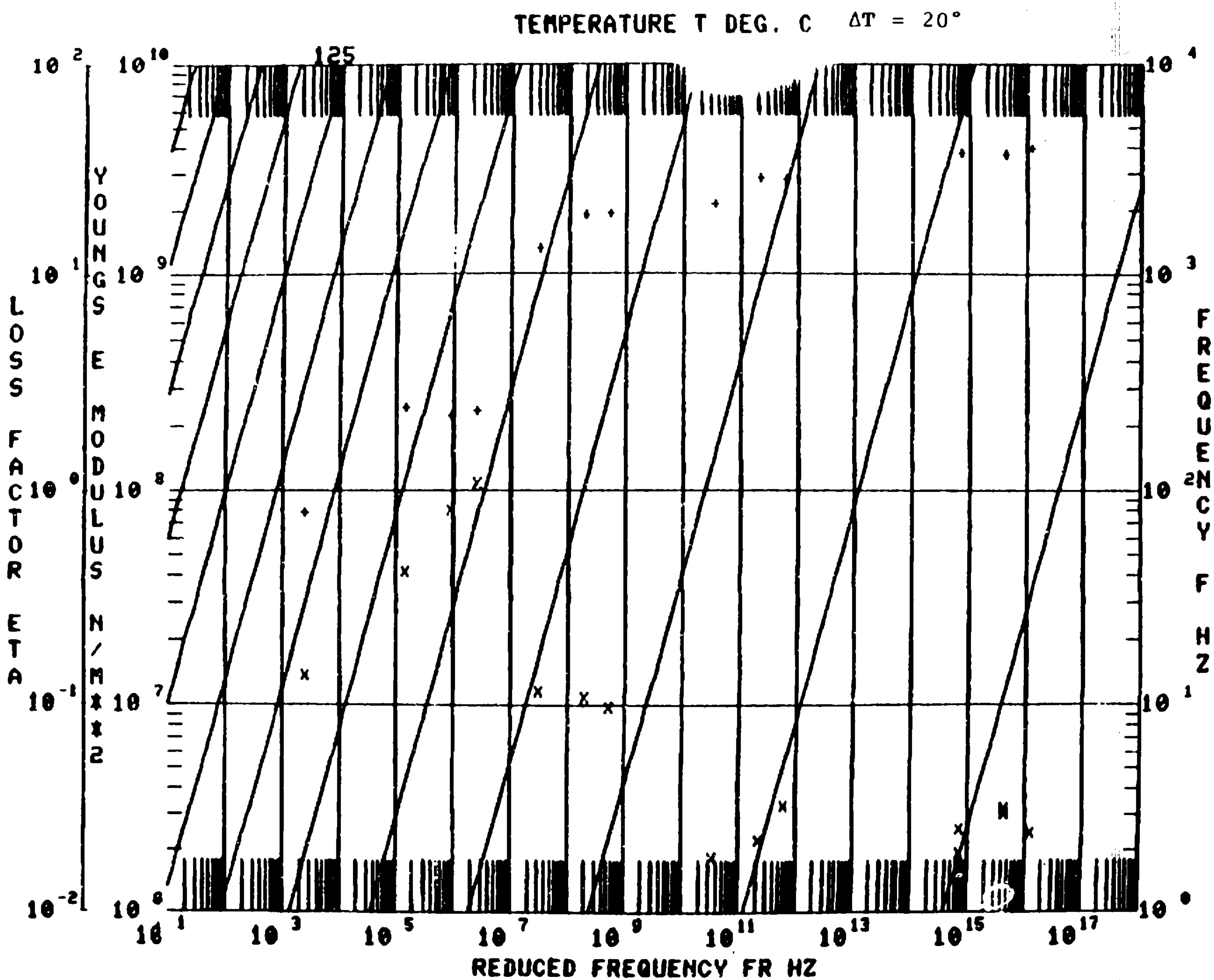
AF-111 Epoxy 3M



AF-126 Epoxy 3M



EC 2216 Epoxy

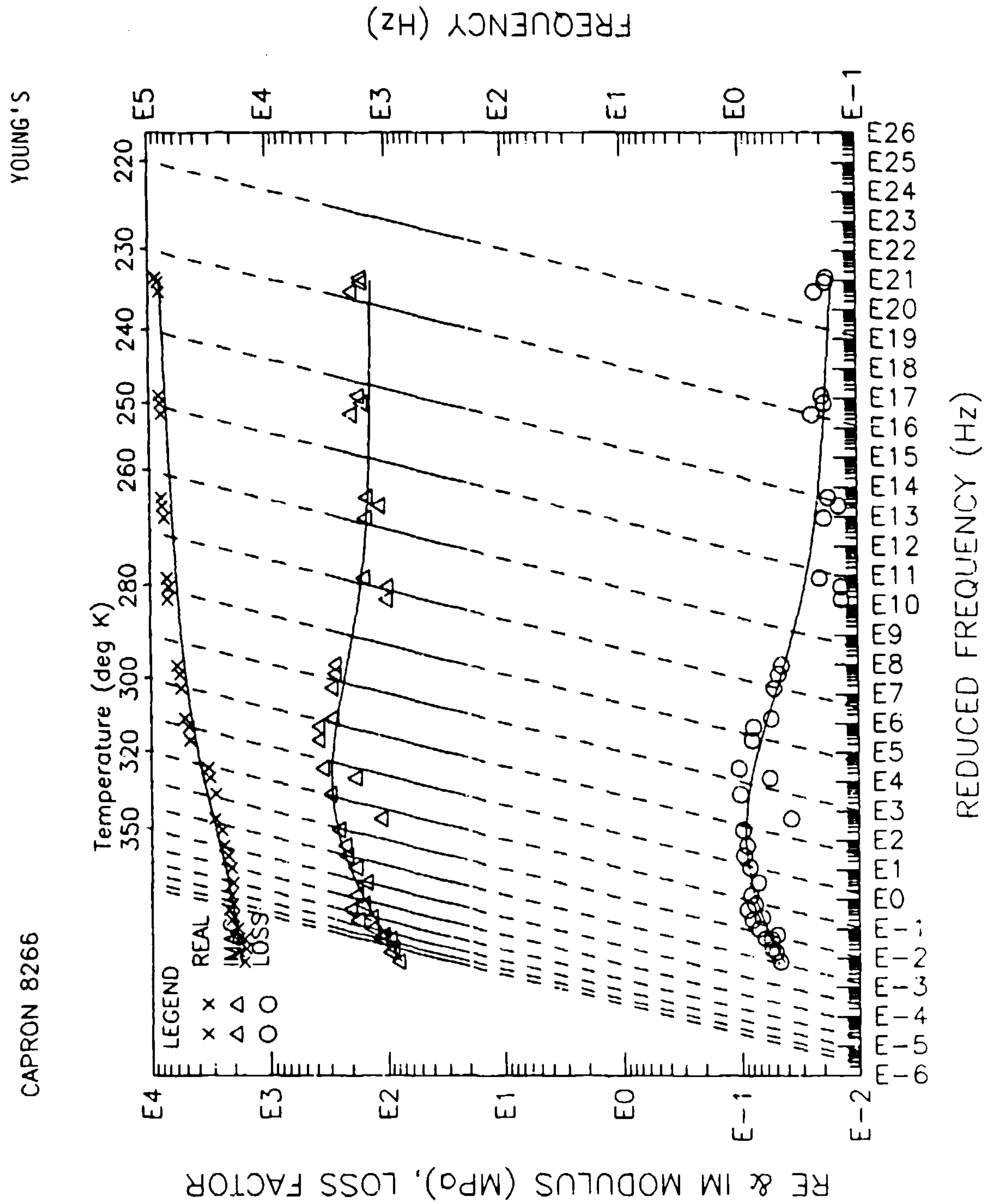


3.2 STRUCTURAL PLASTICS

There is substantial variation in the damping of various structural plastics. The following data set indicates that one structural plastic has a reasonable amount of damping. Damping data on other structural plastics were not available. When a designer has several alternatives in plastics for a structure, vibration problems could be reduced if the plastic with the highest damping is chosen.

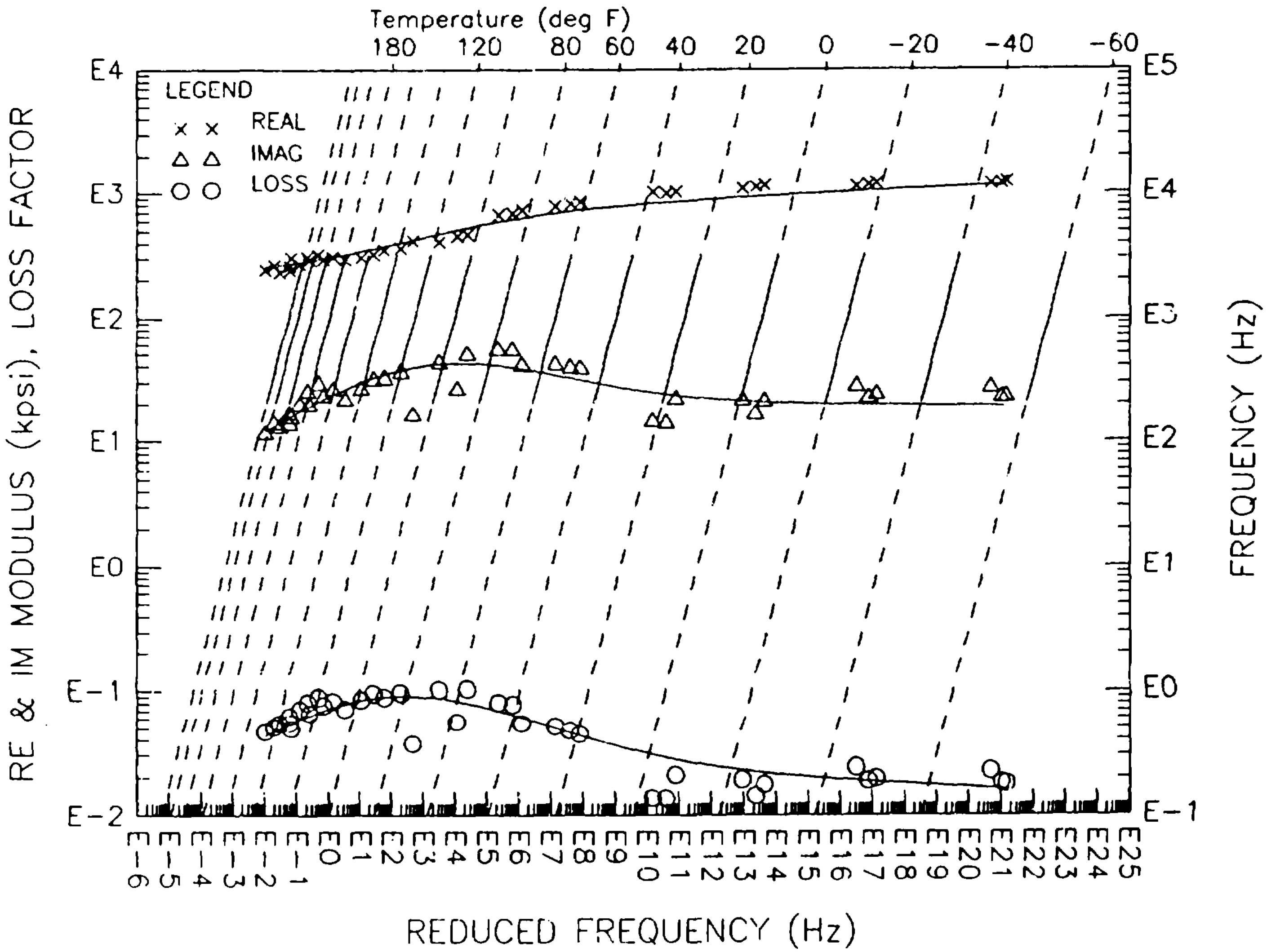
CAPRON 8266 YOUNG'S

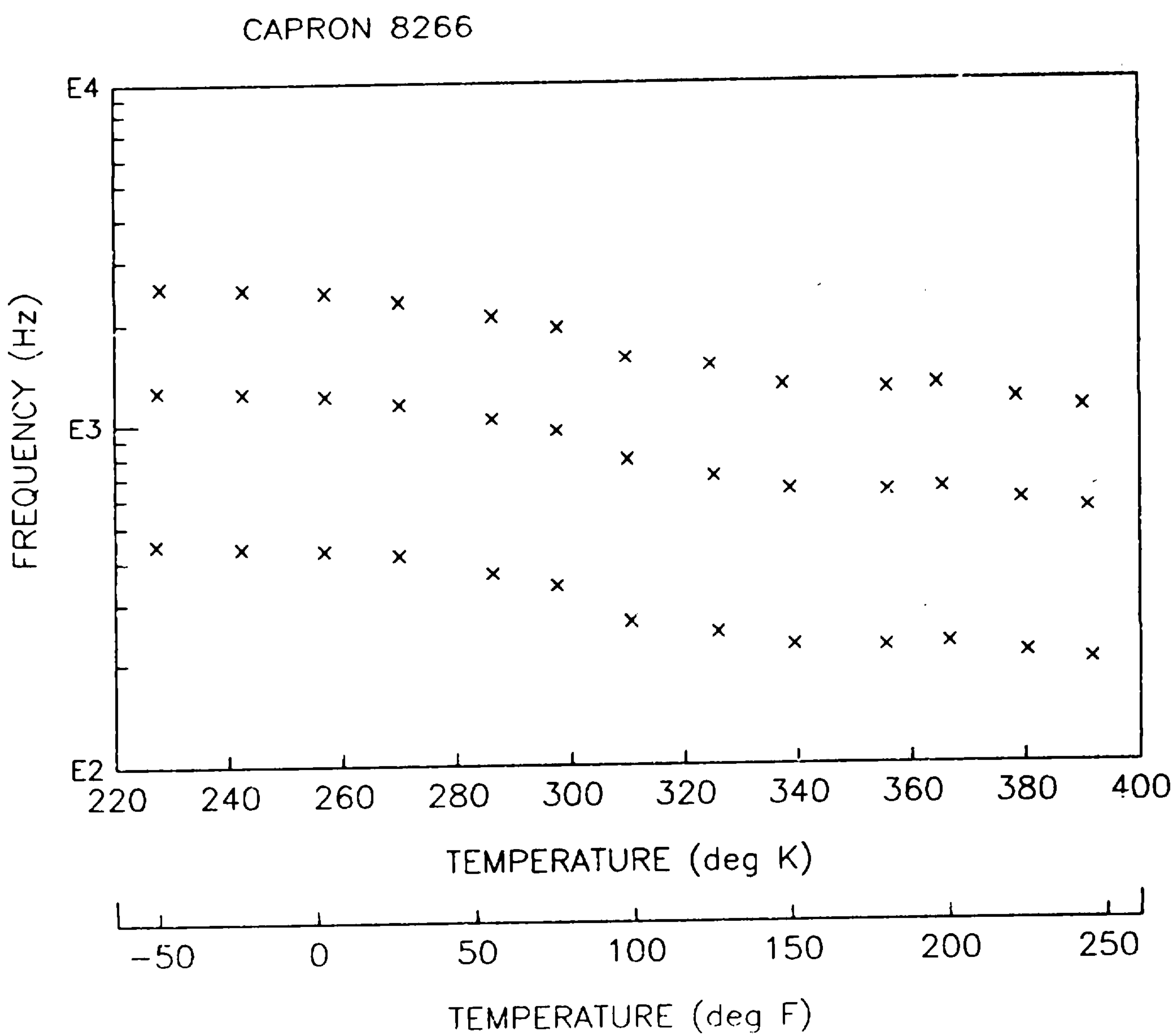
		GLASSY (IE, MAX EXPERIMENTAL REDUCED FREQ)	GLASSY SKIRT 0.7•DMAX	PEAK DMAX	RUBBERY SKIRT 0.7•DMAX	RUBBERY (IE, MIN EXPERIMENTAL REDUCED FREQ)
MTRL LOSS FACTOR		0.1643E-01	0.6407E-01	0.9153E-01	0.6407E-01	0.4327E-01
MODULUS	MPA	7352.	4313.	2847.	1978.	1769.
	PSI	0.1153E+07	0.6255E+06	0.4129E+06	0.2869E+06	0.2566E+06
10.HZ	DEG K		285.0	309.0	338.0	
	DEG C		-8.150	15.85	44.85	
	DEG F		17.33	60.53	112.7	
100.HZ	DEG K		291.0	318.0	351.0	
	DEG C		-2.150	24.85	57.85	
	DEG F		28.13	76.73	136.1	
1000.HZ	DEG K		298.0	327.0	369.0	
	DEG C		4.850	33.85	75.85	
	DEG F		40.73	92.93	168.5	

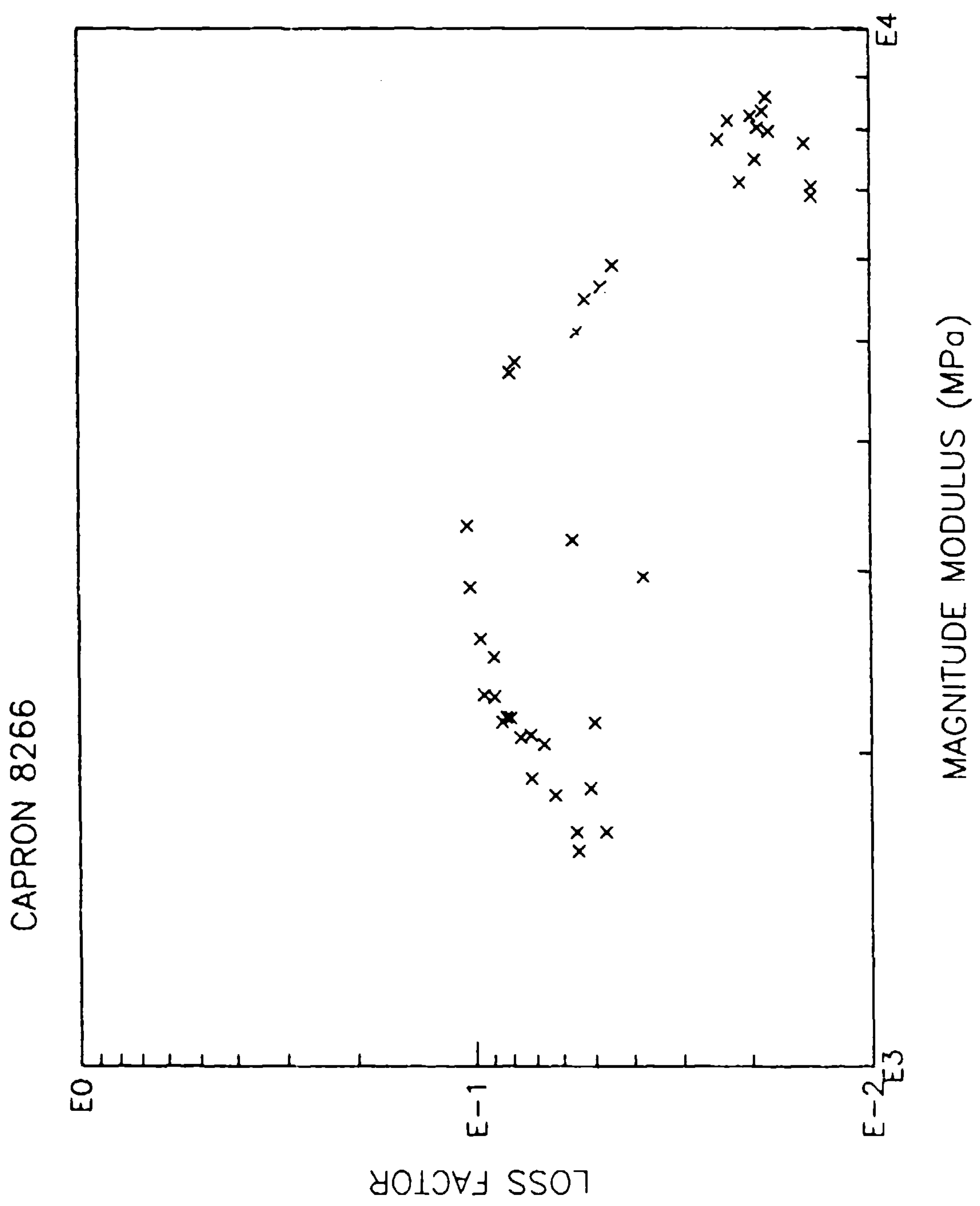


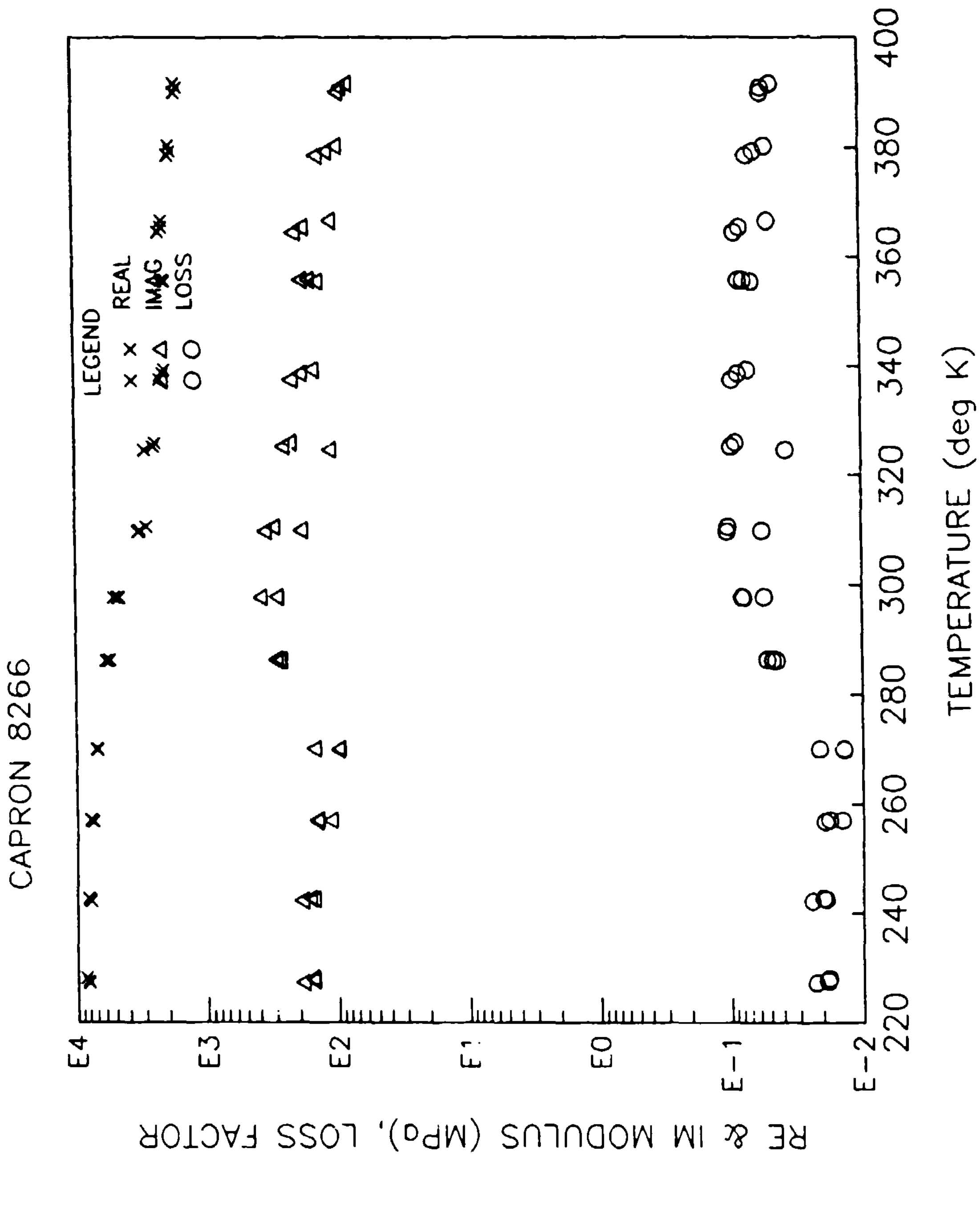
CAPRON 8266
YOUNG'S
Temperature (deg K)
LEGEND
REAL
IMAG
LOSS
FREQUENCY (Hz)
REDUCED FREQUENCY (Hz)
RE & IM MODULUS (MPa), LOSS FACTOR

047 CAPRON 8266 YOUNG'S

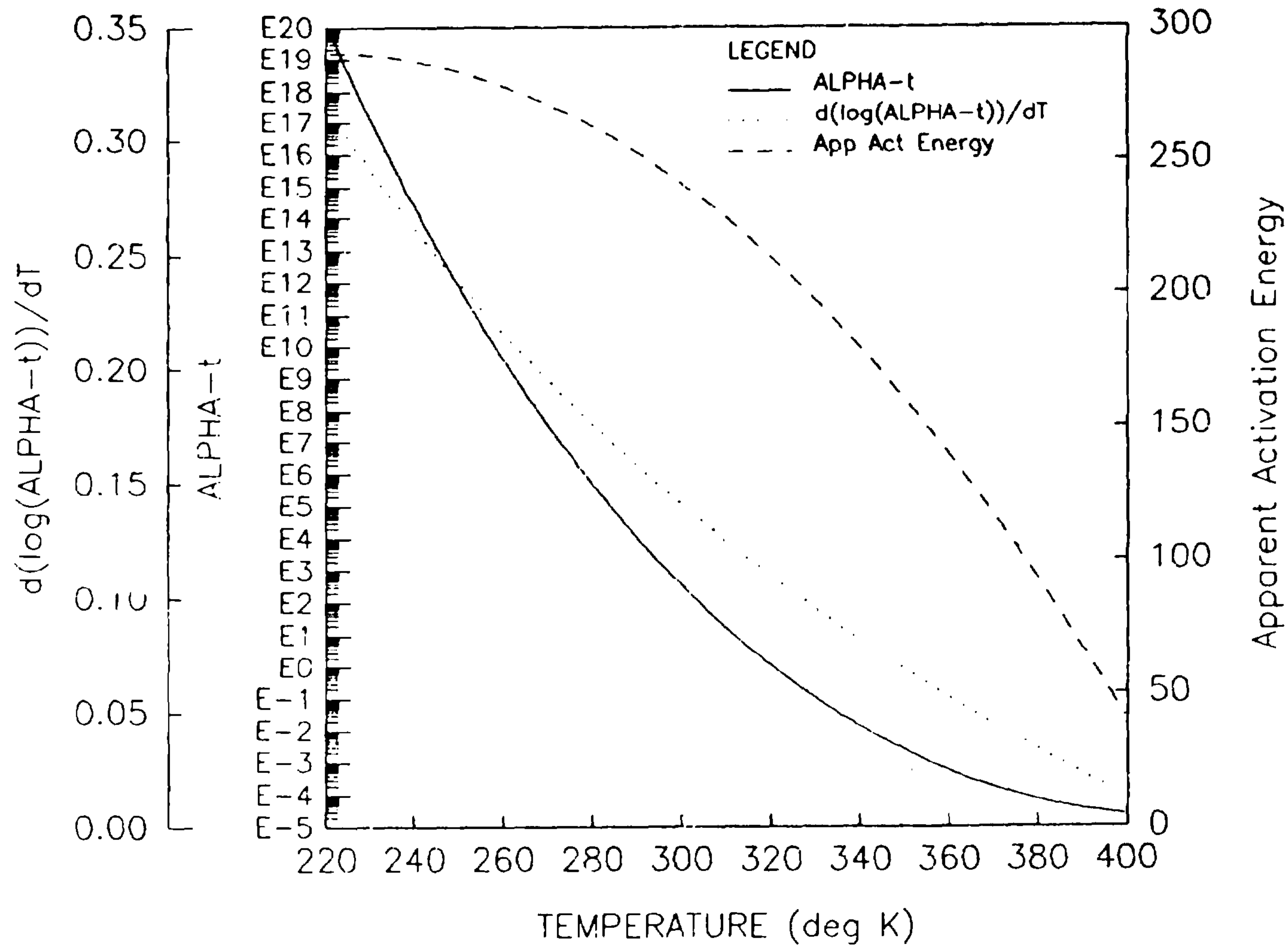



CAPRON 8266
FREQUENCY (Hz)
E4
E3
E2
220
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)
-50
0
50
100
150
200
250
TEMPERATURE (deg F)


CAPRON 8266
LOSS FACTOR
MAGNITUDE MODULUS (MPa)
E0
E-1
E-2
E3
E4


CAPRON 8266
LEGEND
× × REAL
△ △ IMAG
○ ○ LOSS
RE & IM MODULUS (MPa), LOSS FACTOR
E4
E3
E2
E1
E0
E−1
E−2
220
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)

CAPRON 8266



LEGEND
ALPHA-t
d(log(ALPHA-t))/dT
App Act Energy
d(log(ALPHA-t))/dT
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
ALPHA-t
E20
E19
E18
E17
E16
E15
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
E0
E-1
E-2
E-3
E-4
E-5
Apparent Activation Energy
300
250
200
150
100
50
0
220
240
260
280
300
320
340
360
380
400
TEMPERATURE (deg K)

CAPRON 8266 YOUNG'S

ALFA-T MODEL							
NALF	NA	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
5	6	320.0	220.0	400.0	0.1090	0.3144	0.1296E-01

COMPLEX MODULUS MODEL							
NVEM	NB	B(1)	B(2)	B(3)	B(4)	B(5)	B(6)
7	6	1508.	0.1186E+05	0.5673E+06	0.2007	2.259	0.2808E-01

COMPLEX MODULUS DATA AS A FUNCTION OF TEMPERATURE AND FREQUENCY

Temp (DEG K)	Freq (HZ)	MReal (MPA)	Eta	MImag (MPA)
297.4	337.5	4630.	0.8060E-01	373.2
297.4	957.5	4750.	0.7840E-01	372.4
297.5	1939.	5080.	0.5490E-01	278.9
227.0	447.3	8140.	0.2280E-01	185.6
227.4	1266.	8310.	0.1860E-01	154.6
227.9	2521.	8580.	0.1820E-01	156.2
242.0	438.2	7800.	0.2420E-01	188.8
242.3	1244.	8020.	0.1910E-01	153.2
242.5	2477.	8220.	0.1990E-01	163.6
256.6	428.8	7470.	0.1940E-01	144.9
256.8	1222.	7740.	0.1450E-01	112.2
256.9	2427.	7950.	0.1790E-01	142.3
269.7	416.2	7040.	0.1390E-01	97.86
286.1	366.4	5460.	0.5210E-01	284.5
286.0	1040.	5610.	0.4760E-01	267.0
286.0	2089.	5890.	0.4460E-01	262.7
310.4	265.5	2870.	0.1021	293.0
309.7	755.0	3200.	0.5660E-01	181.1
309.5	1561.	3290.	0.1040	342.2
325.7	246.1	2460.	0.8940E-01	219.9
325.0	702.8	2560.	0.9670E-01	247.6
324.4	1479.	2950.	0.3750E-01	110.6
339.1	225.4	2070.	0.7190E-01	148.8
338.4	640.2	2130.	0.8510E-01	181.3
337.3	1295.	2260.	0.9490E-01	214.5
355.3	223.7	2030.	0.6670E-01	135.4
355.5	629.6	2060.	0.7640E-01	157.4
355.5	1261.	2150.	0.8300E-01	178.4
366.4	228.9	2130.	0.4980E-01	106.1
365.2	643.4	2150.	0.8100E-01	174.1
364.3	1292.	2250.	0.8900E-01	200.3
380.1	212.9	1840.	0.5120E-01	94.21
379.1	591.4	1810.	0.6270E-01	113.5
378.3	1181.	1880.	0.7140E-01	134.2
391.5	202.5	1670.	0.4690E-01	78.32
390.8	554.8	1600.	0.5500E-01	88.00
389.9	1113.	1670.	0.5560E-01	92.85
269.8	1152.	6890.	0.1390E-01	95.77
269.8	2292.	7090.	0.2120E-01	150.3

3.3 MATERIAL DATA FOR COMPOSITES AND METALS

Typical material data for composite materials and metals, used in the aerospace industry, are summarized in Tables 3 and 4, respectively.

All of the undirectional lamina data and the Kevlar cloth data for the 0.69 fiber volume fraction in Table 3, have been taken from Reference 3. The unidirectional lamina and fabric data from Kevlar at the 0.5 fiber volume fraction, are based on test data developed by Dupont and Lockheed-California Company in the early 1970's.

The crossplied laminate data, in Table 3, has been extracted from the carpet plots in Volume I of Reference 3. These data indicate that the elastic properties of composite structures are highly dependent on the fiber orientations used in the laminate. The carpet plots, in Reference 3, can be used to obtain the elastic properties for laminates with other fiber orientations. These crossplied laminate elastic properties are average values, for use with axial loading. These average values can be used to estimate the flexural stiffness of symmetric laminates with reasonable accuracy, provided the laminates have eight or more plies.

The material data, in Table 4, have been taken from References 4 and 5. The 1984 Material Selector, in Material Engineering [5] is a good source of data for a wide range of metallic and non-metallic materials.

Damping data for typical structural materials is given in Tables 5 and 6. The data from Table 5 is from Reference 6 and the data from Table 6 is from Reference 7. Figures 9 and 10 and Tables 7 and 8 present additional data from Reference 8.

TABLE 3

TYPICAL ROOM TEMPERATURE COMPOSITE MATERIAL PROPERTIES

Material	Fiber Volume V_f	Nominal Thickness IN.	Density Lb/in^3 ρ	Modulus - MSI Longitudinal E_L	Modulus - MSI Transverse E_T	Modulus - MSI Shear G_{LT}	Poisson's Ratio ν_{LT}	Coefficient of Thermal Expansion μin/in/°F Longitudinal α_L	Coefficient of Thermal Expansion μin/in/°F Transverse α_L
UNIDIRECTIONAL LAMINA									
Boron/Epoxy	0.5	0.0052	0.073	30	2.7	0.7	0.21	2.3	10.6
Boron/Aluminum	0.5	0.007	0.098	32	21.5	8.3	0.26	3.2	10.6
Graphite/Epoxy									
High Strength*	0.6	0.005	0.056	21	1.7	0.65	0.3	-0.21	16.0
High Modulus	0.6	0.005	0.056	30	1.2	0.65	0.3	-0.3	19.5
Ultra High Modulus	0.64	0.005	0.063	50	0.92	0.69	0.32	-0.45	13.0
Kevlar-49	0.5	0.005	0.050	10.6	0.7	0.29	0.33	-0.28	32.0
CROSSPLIED LAMINATE $(0°/\pm 45°/90°)_s$ **									
Boron/Epoxy	0.5	0.042	0.073	11.3	11.3	4.2	0.33	3.2	3.2
Graphite/Epoxy									
High Strength*	0.6	0.040	0.056	8.0	8.0	3.1	0.32	1.2	1.2
High Modulus	0.6	0.040	0.056	10.8	10.8	4.2	0.32	1.3	1.3
Ultra High Modulus	0.64	0.040	0.063	17.6	17.6	6.5	0.32	0.8	0.8
CROSSPLIED LAMINATE $(0°/\pm 45°)_s$ **									
Boron/Epoxy	0.5	0.031	0.073	12.0	5.2	5.4	0.76	2.1	4.8
Graphite/Epoxy									
High Strength*	0.6	0.030	0.056	8.6	3.8	3.8	0.74	-0.4	4.0
High Modulus	0.6	0.030	0.056	12.0	4.6	5.3	0.82	0.3	3.4
Ultra High Modulus	0.64	0.030	0.063	18.5	6.8	8.6	0.88	0.4	1.6
FABRIC - 181 STYLE WEAVE									
Kevlar-49	0.5	0.09	0.05	4.56	4.7	0.35	0.15	--	---
	0.69	0.08	0.049	5.2	5.2	0.36	0.12	2.3	3.3

* Ultimate Tensile Strength 180 KSI

** Subscript s Denotes a Symmetric Layup

TABLE 4
TYPICAL ROOM TEMPERATURE MATERIAL PROPERTIES FOR METALS

Material	Density Lb/in^3 P	Modulus MSI E	Poisson's Ratio ν	Thermal Expansion Coefficient αin/in/°F α
Aluminum Alloy				
2024	0.10	10.6	0.33	12.9
7075	0.101	10.4	0.33	13.1
Berillium	0.067	42.0	0.081 (sheet)	6.2
Magnesium Alloy	0.065	6.5	0.35	14.0
Molybdenum	0.37	47.0	0.32	2.9
Steel Alloy				
AISI 4130	0.283	29.0	0.32	6.3
5CR-MO-v	0.281	30.0	0.32	7.1
9NI-4CO	0.284	28.5	0 32	6.4
17-7PH	0.276	29.5	0.32	5.9
Titanium Alloy				
6Al-4V	0.16	16.2	0.31	5.2
8AL-IMO-IV	0.158	17.7	0.32	5.6

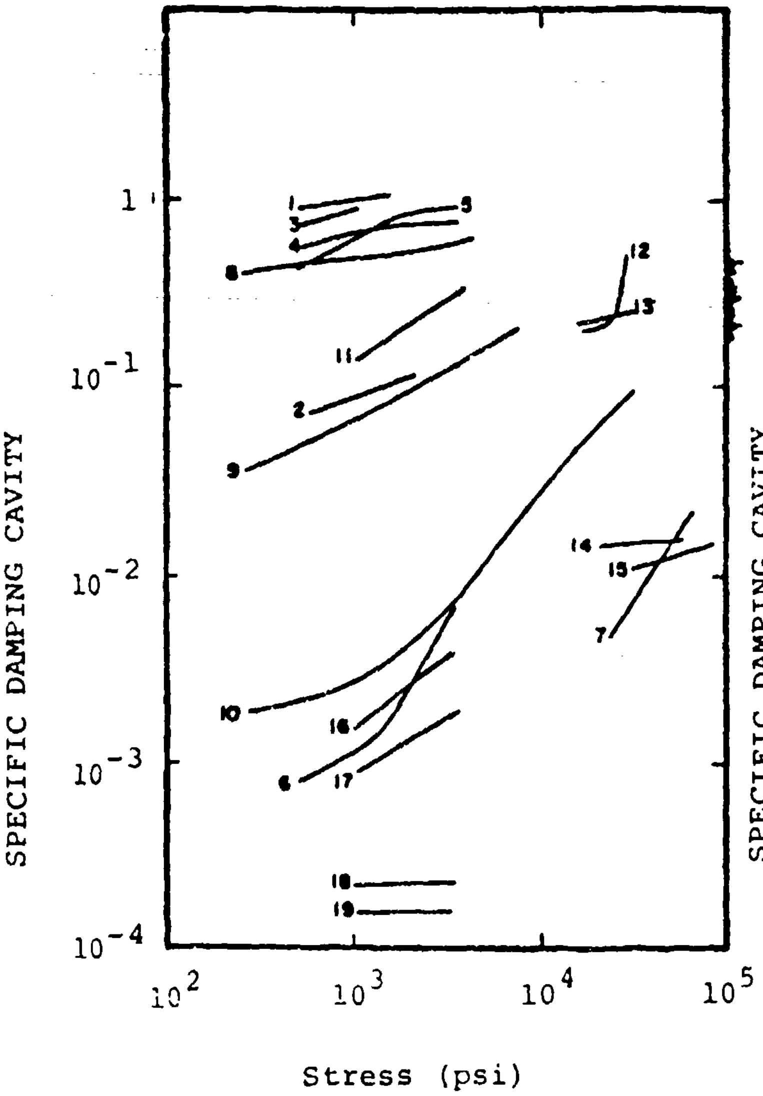


Figure 9 Damping vs. Stress Amplitude for Materials in Table 7.

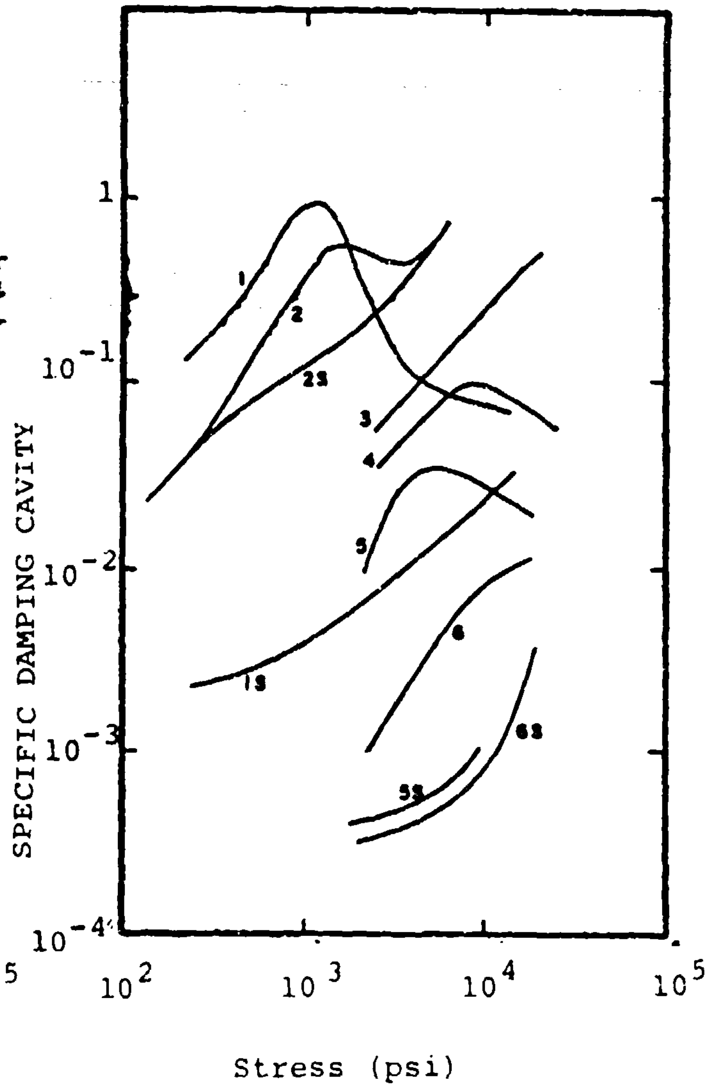


Figure 10 Magnetomechanical Damping vs. Stress Amplitude for Materials in Table 8.

TABLE 5

DYNAMIC MECHANICAL PROPERTY RANGES
FOR SOME COMMON STRUCTURAL MATERIALS

Material	Loss Factor	Tensile Modulus E_1 psi x 10^4
Metals	0.0001 to 0.001	5.0 to 35.0
Glass	0.001 to 0.005	8.0 to 12.0
Concrete, bricks	0.001 to 0.01	1.0 to 10.0
Sand, granular media	0.01 to 0.05	0.1 to 3.0
Wood, cork, plywood	0.01 to 0.20	0.5 to 2.5
Rubbers, plastics	0.001 to 10.0	0.00001 to 0.5

TABLE 6

Typical loss factors of structural materials at small amplitudes, at room temperature, and in the audio frequency range.

Material	Loss Factor
Aluminum	10^{-4}
Brass, bronze	$< 10^{-3}$
Brick	1 to 2×10^{-2}
Concrete	
light	1.5×10^{-2}
porous	1.5×10^{-2}
dense	1 to 5×10^{-2}
Copper	2×10^{-3}
Cork	0.13 to 0.17
Glass	0.6 to 2×10^{-3}
Gypsum board	0.6 to 3×10^{-2}
Lead	0.5 to 2×10^{-3}
Magnesium	10^{-4}
Masonry blocks	5 to 7×10^{-3}
Oak, fir	0.8 to 1×10^{-2}
Plaster	5×10^{-3}
Plexiglass, Lucite	2 to 4×10^{-2}
Plywood	1 to 1.3×10^{-2}
Sand, dry	0.6 to 0.12
Steel, iron	1 to 6×10^{-4}
Tin	2×10^{-3}
Wood fiberboard	1 to 3×10^{-2}
Zinc	3×10^{-4}

TABLE 7

MATERIAL IDENTIFICATION AND PHYSICAL PROPERTIES FOR DAMPING SPECIMENS

Sample Number	Material	Tensile Strength (psi x 10^{+3})	Damping Mechanism
1	Plexiglass	7-10	Viscoelastic
2	Polystryene	Not available	Viscoelastic
3	Cast magnesium 99.9% pure	10	Dislocation
4	Mg - 0.6% Zn	21.6	Dislocation
5	Mg - 0.9%	13.5	Dislocation
6	Mg - 8%Al,0.5%Zn 0.2% Mn	52	Dislocation
7	Austenitic steel Oil quenched from 1000°C, 16 hours. 650°C	130	Dislocation
8	Pearlitic gray cast iron 3.63%C, 3.39%Si, 0.54%Mn	17.3	Graphite flake
9	Pearlitic gray cast iron 3.01%C, 2.49%Si, 0.53Mn	41	Graphite flake
10	Pearlitic nodular cast iron	88	Graphite nodules
11	Mn-35.9%Cu, 0.24%Fe, Heat 1 hr. 790°C, quench-2 hr. 450°C	95	Two phase material
12	N-155 Alloy, Fe 21.7%Cr, 1.9%W, 0.15%C, 19.4%Ni, 1.74%Mn, 19%Co, 0.76%Cb, 2.76%Mo, 0.37%Si quenched, aged	119(room temp)	High Temperature Damping (1500°F)
13	Stellite Co-0.45%C, 1.4%Fe, 0.42%Mn, 24.8%Cr, 0.93%Si, 10.4%Ni, 7.26%W as cast	92.6(room temp)	High temperature damping (1500°F)

TABLE 7 (continued)

Sample Number	Material	Tensile Strength (psi x 10^{+3})	Damping Mechanism
14	Ti-3.9%Al, 4.3% Mn, 0.1%C annealed	152(room temp)	High temperature damping (600°F)
15	Sandvik Steel Fe-1%Cr, 0.2%Si, 1%C, 0.26%Mn, 0.24% Mo, quenched tempered	204	Not available
16	Free cutting brass Cu-35%Zn, 3%Pb	55	Not available
17	Al-5.5%Cu 0.5%Pb, 0.5%Bi	53	Not available
18	Al-4%Cu, 0.5%Mg 0.5% Mn	62	Not available
19	Naval brass Cu-39%Zn, 1%Sn	69	Not available

TABLE 8

MATERIAL IDENTIFICATION AND PHYSICAL PROPERTIES OF SPECIMENS HAVING MAGENTOMECHANICAL DAMPING

Sample Number	Material	Tensile Strength (psi x 10^{+3})	Damping Mechanism
1	Fe-3.3%Si anneal 5.5 hr @ 1200°C	78	Magnetomechanical
1S	Sample 1 Saturation Magnetic Field		
2	Pure Nickel	50-80	Magnetomechanical
2S	Sample 2 - Saturation Magnetic Field		
3	NIVCO 73.5%Co,22.5%Ni, 1.8%Ti, 1.1%Zr	Not available	Magnetomechanical
4	403 Steel Alloy Fe-12%Cr, 5%Ni	129	Magnetomechanical
5	Mild steel 0.28%C,0.2%Si 0.79%Mn,0.12%Cu, 0.14%Ni,0.1%Cr, annealed 18 hrs at 625°C	Not available	Magnetomechanical
5S	Sample 5 Saturation Magnetic Field		
6	Carbon Steel 0.42%C, 0.32%Si, 0.99%Mn,0.09%Ni, 0.06Cr,normalized	Not available	Magnetomechanical
6S	Sample 6 Saturation Magnetic Field		

SECTION 4

DAMPING MATERIAL MANUFACTURERS

The Soundcoat Company
175 Pearl Street
Brooklyn, NY 11201
(212) 858-4100

3M Company
3M Center
Building 231-F
St. Paul, MN 55101
(612) 733-3564

University of Dayton
Research Institute
Jesse Philips Center
300 College Park Ave.
Dayton, OH 45469-0001
(513) 229-2644

Corning Glass Works
Corning, NY 14830

Allied Chemical Company
Specialty Chemical Division
P.O. BOX 1057R
Morristown, NJ 07960

E.I. DuPont de Nemours & Co.,Inc. (Rep)
2951 Clark Pkwy
West Lake, OH 44145
(Elastomer Chemical Dept.,
Wilmington, DE)

General Electric Co.
Silicone Products Dept.
Waterford, NY 12188

Dow Corning Corp.
S. Saginaw Rd
Midland, MI 48640

Ferro Corp.
Technical Center
7500 E. Pleasant Valley Rd
Independence, OH 44131

Allforce Acoustics
United McGill Corp.
2000 West Grandview Blvd.
P.O. Box 10038
Erie, PA 16514-0038

E-A-R Division of Cabot Corp.
7911 Zionville Road
Indianapolis, IN 46268
(317) 293-1111

Pemco Products Group
Chemical and Metallurgical Division
S.C.M. Corporation
5601 Eastern Avenue
Baltimore, MD 21224

The O'Hommel Company
P.O. BOX 475
Pittsburgh, PA 15230

Solar Turbine, Inc.
2200 Pacific Hwy
P.O. BOX 80961
San Diego, CA 92138

Scott Foam Division
Scott Paper Company
1500 E. Second St.
Chester, PA 19017

Union Carbide Corp.
Chemicals & Plastics
River Rd
Bound Brook, NJ 08805

Uniroyal, Inc.
Elm St
Nangatuck, CT 06770

Shell Chemical Co.
One Shel Plaza
P.O. BOX 2463
Houston, TX 77001

DAMPING MATERIAL MANUFACTURERS (continued)

B.F. Goodrich Aerospace & Def Products
Research Center
Brecksville, OH 44141

Mystik Tpae, Div. of Borden, Inc.
180 E. Broad St.
Columbus, OH 43215

Amoco Chemicals
200 East Randolph Drive
Chicago, IL 60601

Union Carbide Corp.
2[illegible]0 Park Avenue
New York, NY 10017

B.F. Goodrich
6100 Oak Tree Blvd.
Cleveland, OH 44131

Phillips Chemical Company
Drawer "O"
Borger, TX 79007

ICI Americas, Inc.
Wilmington, DE 19817

Upjohn Company
Laporte, TX 77571

AIRTEX INDUSTRIES INC

3558 2ND ST N
MINNEAPOLIS MN
55412
612-522-3643

AMBER/BOOTH CO INC

1403 N POST OAK
HOUSTON TX
77055
713-688-1228

AMERICAN ACOUSTICAL PRODUCTS

9 COCHITUATE ST
NATICK MA
01760
617-655-0870

ANTIPHON INC

62 OMEGA DR
NEWARK DE
19713
302-454-7665

ARMSTRONG WORLD INDUST INC

PO BOX 3001
LANCASTER PA
17604
717-397-0611

ARVIN
ARVINYL (AVDEC)
BOX NO 3002
COLUMBUS IN
47202
812-379-3000

BARLEY-EARHART CO

233 DIVINE HWY
PORTLAND MI
48875
517-647-4117

BRD NOISE AND VIB CONTROL

112 FAIRVIEW AVE PO BOX 127
WIND GAP PA
18091
215-863-6300

CA[illegible]T CORP
E-[illegible]-R DIV
7911 ZIONSVILLE RD
INDIANAPOLIS IN
46268
317-872-1111

CONTROLLED ACOUSTICS CORP

12 WILSON ST
HARTSDALE NY
10530
914-428-7740

DESIGNATRONICS INC
STOCK DRIVE PRODUCTS
2101 JERICHO TURNPIKE
NEW HYDE PARK NY
11040
516-328-3300

DURACOTE CORP

350 DIAMOND ST
RAVENNA OH
44266
216-296-9600

E N MURRAY CO INC

707 UMATILLA ST
DENVER CO
80204
303-892-1106

EMHART CORP
BOSTIK DIV
BOSTON ST
MIDDLETON MA
01949
617-777-0100

FROMMELT INDUST INC

4343 CHAVENELLE RD
DUBUQUE IA
52004
800-553-5560

GREAT LAKES INDUST ASSOCIATES

1221 S BOWEN ST PO BOX 628
JACKSON MI
49204
517-784-7146

LAUREN MANUFACTURING CO

2228 REISER AVE SE
NEW PHILADELPHIA OH
44663
216-339-3373

MANVILLE CORP

PO BOX 5108
DENVER CO
80217
303-978-4900

ECKEL INDUSTRIES INC
ACOUSTICS DIV
155 FAWCETT ST
CAMBRIDGE MA
02138
617-491-3221

ENGRG SALES AND SERVICES

PO BOX 558
DAYTON OH
45405
513-277-2047

GLOBE INDUST INC

2638 EAST 126TH ST
CHICAGO IL
60633
312-646-1300

INDUSTRIAL NOISE CONTROL INC

1411 JEFFREY DR
ADDISON IL
60101
312-620-1998

LINEAR PRODUCTS CORP

PO BOX 902
CRANFORD NJ
07016
201-272-2211

MIDWEST ACOUST-A-FIBER INC

7790 MARYSVILLE RD
OSTRANDER OH
43061
614-666-2231

NOISE CONTROL ASSOCIATES INC

32 PARK ST
MONTCLAIR NJ
07042
201-746-5181

NOISE CONTROL CO

443 OAK GLENN DR
BARTLETT IL
60103
312-830-0090

NOISE REDUCTION CORP

RT 2 PO BOX 152
REDWOOD FALLS MN
56283
507-644-3067

OWENS-CORNING FIBERGLASS CORP

FIBERGLASS TOWER
TOLEDO OH
43659
419-248-8000

PEABODY NOISE CONTROL INC

6300 IRELAN PLACE
DUBLIN OH
43017
614-889-0480

PRESTO MANUF CO INC

2 FRANKLIN AVE
BROOKLYN NY
11211
718-852-0187

ROGERS CORP

WOODSTOCK RD
E WOODSTOCK CT
06244
203-774-9605

SINGER SAFETY CO

3800 N MILWAUKEE AVE
CHICAGO IL
60641
800-621-0089

SMART AIM CO

PO BOX 1006
FRAMINGHAM MA
01701
617-877-4308

SOUNDCOAT CO INC

ONE BURT DR
DEER PARK NY
11729
516-242-2200

SPECIALTY COMPOSITES CORP

DELAWARE INDUSTRIAL PARK
NEWARK DE
19713
800-544-5180

TECH PRODUCTS CORP

5030 LINDEN AVE
DAYTON OH
45432
513-252-3661

TECHNICAL FOAM PRODUCTS

222 RAMPART ST
CHARLOTTE NC
28203
704-333-1131

TECHNICAL MANUF CORP
MICRO-G PRODUCTS
15 CENTENNIAL DR
PEABODY MA
01960
617-532-6330

UNITED MCGILL CORP

1501 KALAMAZOO DR PO BOX 909
GRIFFIN GA
30224
404-228-9864

UNITED PROCESS INC

279 SILVER ST
AGAWAM MA
01001
413-789-1770

VIB MOUNTINGS & CONTROLS

113 MAIN ST PO BOX 37
BLOOMINGDALE NJ
07403

REFERENCES

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[2] Henderson, J. P.and D. I. G. Jones, "Specification of Damping Material Performance," Shock and Vibration Bulletin 48, 1978.

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APPENDIX A

GRAPHICAL PRESENTATION OF DAMPING MATERIAL COMPLEX MODULUS

CXSTD REV 860822.1323

GRAPHICAL PRESENTATION OF DAMPING MATERIAL COMPLEX MODULUS

Proposed Standard

ANSI(ASA)/S2 − 73

ISO/TC108/WG13

Dr Lynn Rogers
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Area B - Building 45 - Room 257
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1. INTRODUCTION

Damping is one potential approach to reducing vibration levels in a structural system. Damping is the dissipation of vibratory energy by converting it into heat, as distinguished from transporting it to another part of the system. When the damping is due to internal energy dissipation within a material which is part of the structural system, and when the damping is of engineering significance, the material is called a vibration damping material. The energy dissipation is due to the stress-strain hystersis loop of the vibration damping material. Other possible sources of damping, such as plastic deformations in the joints, relative slip at joints, air pumping in the joints, acoustic radiation of energy, eddy current losses, etc., are not due to the material and are not covered in the present document.

2. SCOPE

The preferred nomenclature (parameters, symbols and definitions) and graphical presentation of the complex modulus of viscoelastic vibration damping materials which are macroscopically homogenous, linear and thermorheologically simple are given; the complex modulus may be Young's modulus, bulk modulus, longitudinal wave propagation modulus, or Lamé modulus. This graphical presentation is convenient and sufficiently accurate for many vibration damping materials.

The primary purpose is to improve communication among the diverse technological fields concerned with vibration damping materials.

3. RELATED DOCUMENTS

ISO/31/7 - 1978 Quantities, Units, Symbols, Conversion Factors and Conversion Tables (ISO TC 12)
ISO 2041 - 1986 Shock and Vibration Vocabulary (ISO TC 108)
ISO 2856 - 1981 Elastomers - General Requirements for Dynamic Testing (ISO TC 45)
ISO/TR 4137 - 1978 Plastics - Determination of Modulus of Elasticity by Alternating Flexure (ISO TC 61)
ISO 472/DAD 8 (1984) Plastics-Vocubulary-Damping Terminology (ISO TC 61)

4. TERMS AND DEFINITIONS

4.1 COMPLEX MODULUS

The operator form of the constitutive equation for the linear, isothermal, isotropic, macroscopically homogenous, thermorheologically simple (defined after E7) viscoelastic material being deformed in shear is [Ref. 1]

$$P(p_R)\tau(t) = Q(p_R)\gamma(t) \qquad (E1)$$

where $\tau(t)$ is the shear stress, $\gamma(t)$ is the strain, $P(p_R)$ and $Q(p_R)$ are polynomials in p_R, the operator defined as

$$p_R = d/dt_R \tag{E2}$$

where the reduced time is

$$t_R = t/\alpha_T(T) \tag{E3}$$

where t is time and $\alpha_T(T)$ is the temperature shift function dependent on temperature,T[Ref.2]. The fourier transform (f.t.) of E1 leads to the definition of the complex shear modulus valid for steady state sinusoidal stress and strain

$$G(j\omega_R) = \tau^*(j\omega_R)/\gamma^*(j\omega_R) = Q(j\omega_R)/P(j\omega_R) \tag{E4}$$

where $\tau^*(j\omega_R)$ denotes the f.t. of $\tau(t)$ and the reduced radian frequency is

$$\omega_R = \omega\alpha_T(T) = 2\pi f_R = 2\pi f\alpha_T(T) \tag{E5}$$

which is a product of ω, the radian frequency in radians/sec and the dimensionless temperature shift function, while f_R and f are in Hz.

The complex shear modulus

$$G = G(j\omega_R) = G(j\omega\alpha_T(T)) \tag{E6}$$

is dependent on both temperature and frequency

$$G = G(\omega, T) \tag{E7}$$

in a very specific way, i.e.,E6 applies; a material obeying E6 is called thermorheologically simple(TRS). Further, the above equations apply only to linear conditions.

Alternatively, this case may be considered as starting with a viscoelastic material element undergoing a sinusoidal shear strain[Ref. 3]

$$\gamma = \gamma_A sin\omega t \tag{E8}$$

which lags the sinusoidal shear stress

$$\tau = \tau_A sin(\omega t + \delta_G) \tag{E9}$$

by phase angle δ_G. The sinusoidal strain and stress may be represented in complex notation as

$$\gamma^* = \gamma_A e^{j\omega t} \tag{E10}$$

$$\tau^* = \tau_A e^{j(\omega t + \delta_G)} \tag{E11}$$

and the complex shear modulus,G,equivalently defined

$$G = \tau^*/\gamma^* = \tau_A e^{j\delta_G}/\gamma_A = G_M e^{j\delta_G} = G_M cos\delta_G(1 + jtan\delta_G) = G_R + jG_I = G_R(1 + j\eta_G) \tag{E12}$$

where

G_M is the magnitude of the shear modulus,

G_R is the real (storage) modulus,

$G_I = G_R\eta_G$ is the imaginary (loss) modulus, and

$\eta_G = tan\delta_G$ is the material loss factor in shear.

Similar developments apply to the Young's modulus,E, to the bulk modulus, K, to the longitudinal wave propagation modulus,W, and to the Lamé modulus,λ.

A thermorheologically simple material is a material for which the complex modulus is a complex valued function of one independent variable, namely reduced frequency; reduced frequency in turn is a function of frequency and temperature. (In the past, the real modulus and the material loss factor sometimes have been treated as independent functions of reduced frequency; while this has facilitated some satisfactory applications, it is a conceptual error.) The complex modulus evaluated at a given temperature and a given frequency represents both the magnitude and the phase relationships between sinusoidal stress and strain.

4.2 DATA CHECK

This document presumes that a set of valid complex modulus data (e.g., T1) has been obtained in accordance with good practice[e.g., Ref.4]. It is recommended that each set of data be routinely and carefully scrutinized. As a minimum, the log η_G vs log G_M, e.g. F1, should be plotted. If the set of data represents a thermorheologically simple material, if a "vertical shift" is not appropriate and if it has no scatter,it will plot as a curve of vanishing width. A temperature value and a frequency value together lead to a reduced frequency value, which corresponds to a unique location along the arc of the curve; however, this is not considered in this plot. The material loss factor and the modulus magnitude are cross-plotted, and the reduced frequency, temperature, and frequency parameters do not occur explicitly. No part of any scatter in this plot can be attributed to an imperfect temperature shift function.

The log loss factor vs log modulus magnitude plot can reveal valuable information regarding scatter of the experimental data. The width of the band of data as well as the departure of individual points from the center of the band are indicative of scatter. Acceptable scatter depends on the application. Nothing is revealed about the accuracy of the temperature and frequency measurements.

4.3 TEMPERATURE SHIFT FUNCTION

The set of complex modulus data itself implicitly defines the temperature shift function, $\alpha_T(T)$, provided the experimental ranges of temperature and frequency are adequate. It is assumed that a single temperature shift function is adequate.

Because the temperature shift function,$\alpha_T(T)$, has historically had a central role, because its slope, $d(log\alpha_T)/dT$, is the crucial feature that causes data to be correctly shifted, and because the apparent activation energy [Ref. 2]

$$\Delta H_A = 2.303RT^2d(log\alpha_T)/dT \qquad (E13)$$

where the gas constant is

$$R = 0.00828\ newton * km/gram * mole * degK \qquad (E14)$$

is of interest, it is recommended that these three functions be plotted,e.g.,F2a.

4.4 GRAPHICAL PRESENTATION

A set of complex modulus data is presented in F3a using the recommended format. The left vertical logarithmic scale axis is provided for the real and the imaginary modulus components in megaPascal (MPA) units and for the dimensionless loss factor. The horizontal logarithmic scale axis is reduced cyclic frequency, f_R, in Hz. The reduced frequency for the i-th experimental point is given by

$$f_{R_i} = f_i\alpha_T(T_i) \qquad (E15)$$

where f_i is the experimental frequency and T_i is the experimental temperature.

4.4.1 JONES TEMPERATURE LINES

In F3a the right hand side (RHS) vertical logarithmic scale is cyclic frequency in Hz. The nonuniformly spaced diagonal isotherm lines together with the horizontal reduced frequency axis and the RHS vertical frequency axis provide a temperature- frequency-reduced frequency nomogram[Ref. 5]. Taking the logarithm of E5 gives

$$logf_R = logf + log\alpha_T(T) \qquad (E16)$$

which is the equation for a straight line on F3a. Values of temperature in degrees Kelvin divisible by 10 (alternatively, 5, 20 or any other convenient integer) are chosen. The set of isotherm lines implicitly defines the temperature shift function used. The range of the diagonal isotherm lines should be chosen to be the same as the experimental temperature range of data to preclude unintentional and possibly highly erroneous extrapolation. Similarily, the diagonal lines are solid only in the range of experimental frequency. It follows that the reduced frequency scale covers the range from the lowest temperature line and the highest frequency on the RHS scale to the highest temperature line and the lowest frequency.

To follow the illustration included in F3a, enter at a frequency of 200 Hz and proceed horizontally to the intersection with the diagonal line representing 280 degK; the intersection defines a reduced frequency of 12000 Hz; where this vertical reduced frequency line crosses the curves, a real component of 136. MPA, an imaginary component of 116. MPA, and a loss factor of 0.854 are read on the left scale.

4.5 ANALYTICAL REPRESENTATION

While manual processing and interpretation are adequate for some purposes, computerization offers considerable efficiency. Furthermore, analytical representation of the temperature shift function and of the complex modulus provides increased efficiency for design studies. If available, analytical representations should be given, e.g., F2b and F3b. In the event analytical representation is used in design, care must be taken to not extrapolate inadvertently.

4.6 REFERENCES

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3. A.D. Nashif, D.I.G. Jones, and J.P.Henderson, *Vibration Damping*, Wiley, 1985.
4. Standard Method for Measuring Vibration-Damping Properties of Materials, American Society for Testing and Materials, ASTM E 756-83,1983.
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ISSUES

G^* *vs* G

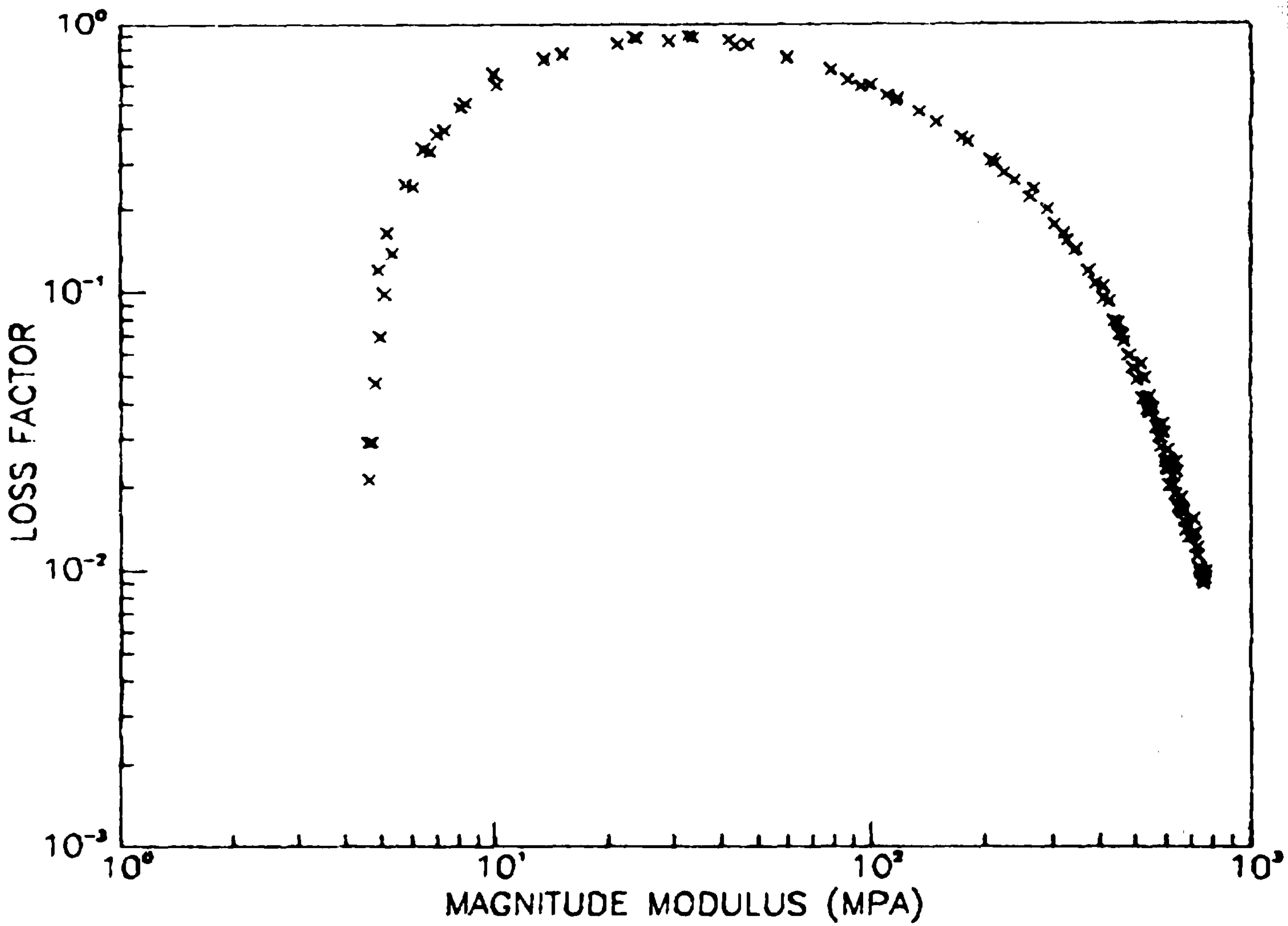
G', G'' *vs* G_R, G_I

i *vs* j

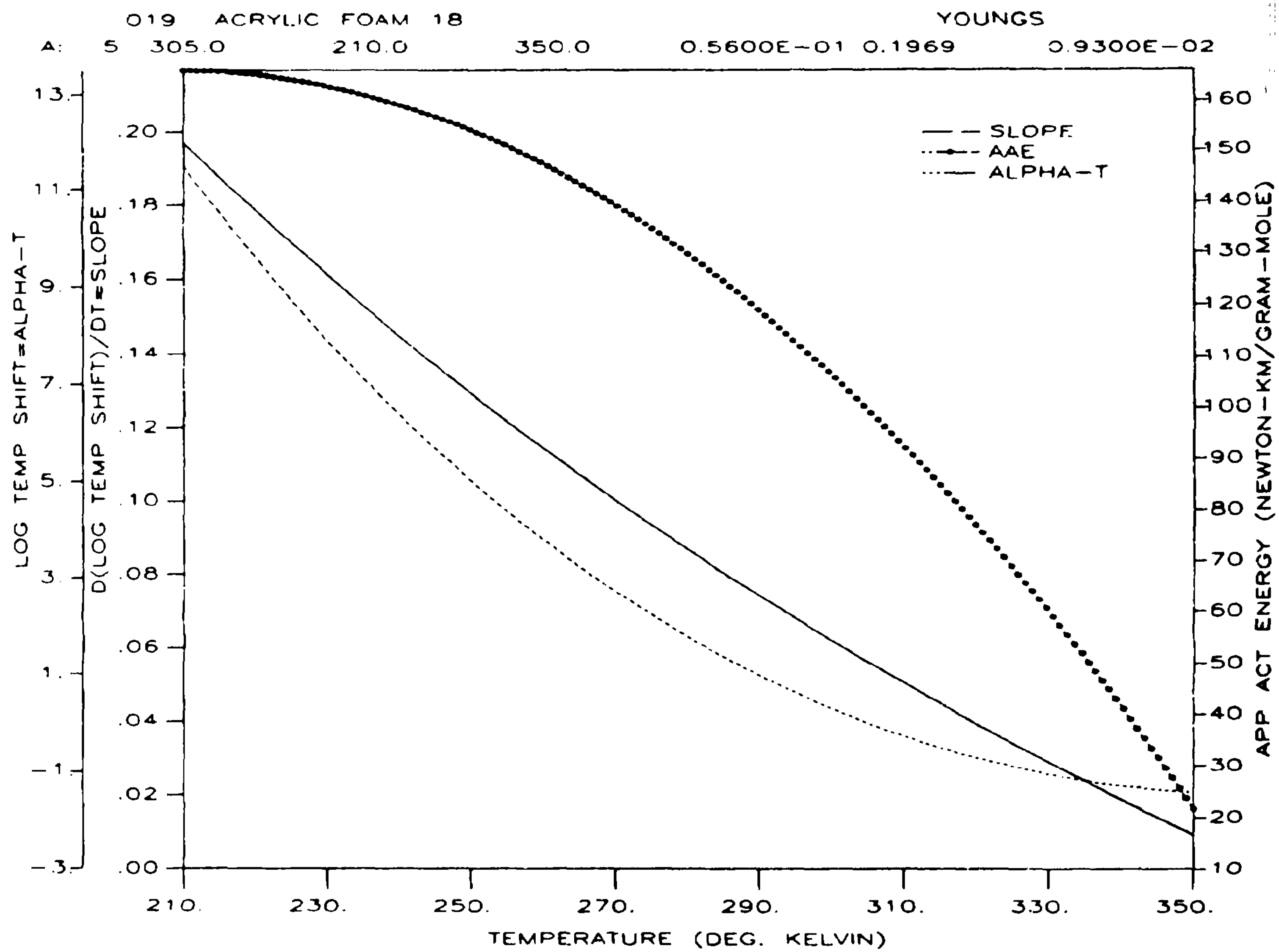
η *vs* d

T1 COMPLEX MODULUS DATA

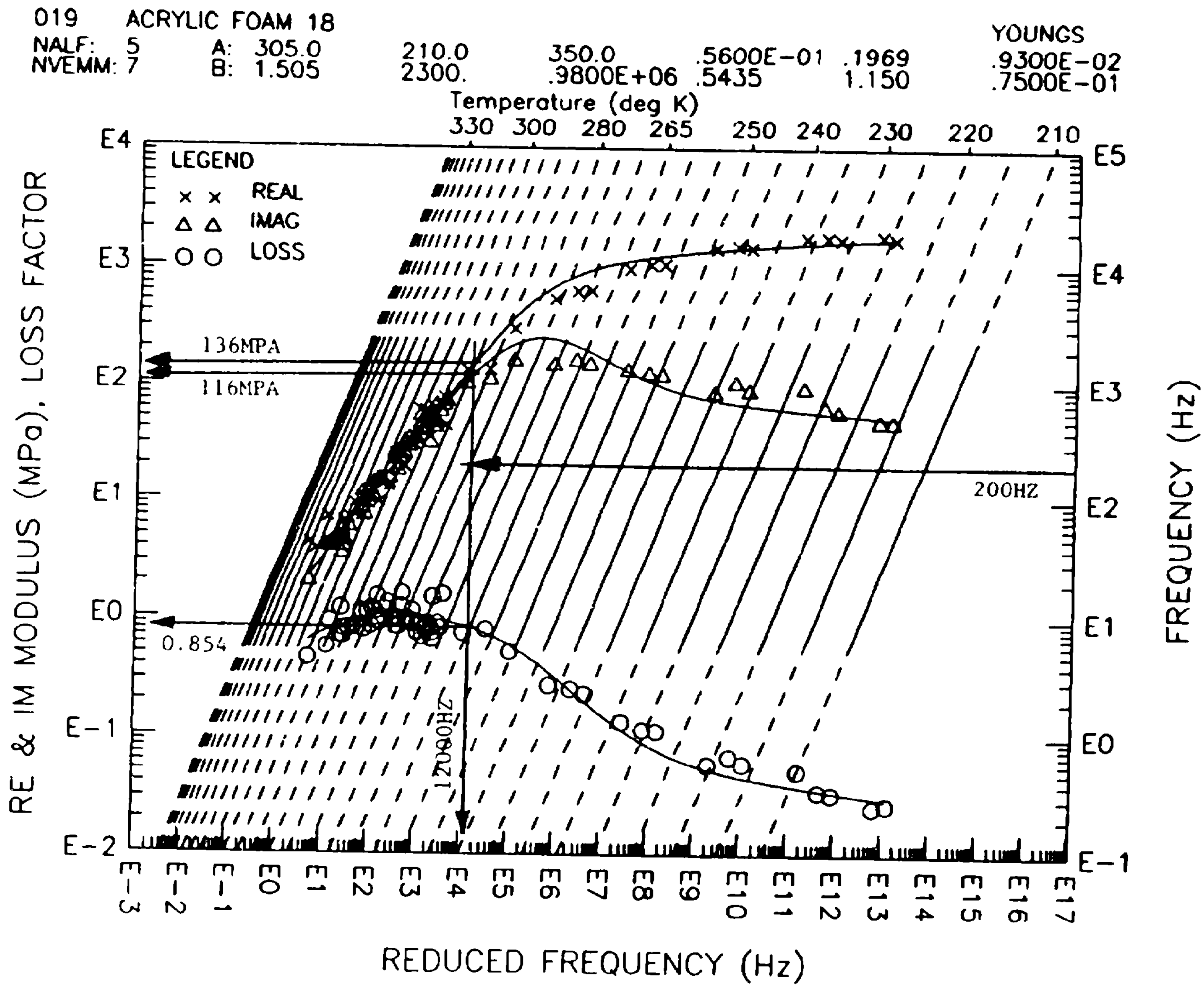
T Deg K	f Hz	G_R MPA	G_I MPA	η
340.4	95.91	4.398	2.002	.4551
340.4	267.2	4.264	3.973	.9318
340.4	522.9	6.567	4.591	.6991
340.4	863.1	9.346	7.768	.8312
340.4	1273.	10.44	11.41	1.093
340.4	1791.	10.76	12.20	1.134
325.4	96.68	7.092	4.042	.5700
325.4	269.4	6.990	5.832	.8344
325.4	525.0	7.254	8.320	1.147
325.4	870.8	12.47	10.66	.8546
325.4	1291.	15.90	14.56	.9157
316.5	96.41	4.924	4.019	.8163
316.5	271.0	9.241	7.340	.7943
316.5	533.9	14.99	15.05	1.004
316.5	873.1	13.04	15.19	1.165
316.5	1305.	20.73	17.77	.8571
316.5	1830.	19.40	31.12	1.604
305.9	97.37	9.077	10.19	1.123
305.9	274.0	13.92	18.57	1.334
305.9	540.1	20.01	24.79	1.239
305.9	903.5	29.88	34.57	1.157
305.9	1886.	34.23	30.92	.9033
295.4	100.6	25.07	25.32	1.010
295.4	289.8	43.67	39.55	.9056
295.4	564.7	43.51	65.22	1.499
295.4	929.0	44.29	70.24	1.586
283.7	110.1	77.00	64.49	.8375
283.7	331.8	132.4	99.79	.7537
273.2	119.6	134.3	109.2	.8134
273.2	398.7	299.5	157.1	.5246
261.5	171.5	534.0	145.8	.2730
261.5	505.5	630.2	159.9	.2537
261.5	993.7	637.8	147.0	.2305
249.3	214.7	976.0	130.8	.1340
249.3	617.9	1063.	122.6	.1153
249.3	1213.	1068.	119.9	.1123
236.5	252.1	1438.	84.27	.0586
236.5	716.9	1516.	102.9	.0679
236.5	1386.	1470.	87.91	.0598
224.8	276.0	1772.	92.32	.0521
224.8	770.5	1788.	62.58	.0350
224.8	1481.	1713.	57.21	.0334
218.2	778.5	1830.	47.40	.0259
218.2	1487.	1726.	46.95	0272
295.4	5.930	4.915	3.494	.7108
295.4	77.74	23.19	22.15	.9551
295.4	154.3	31.35	28.74	.9167
295.4	260.3	59.28	44.69	.7538
295.4	385.0	54.31	45.48	.8374
295.4	545.2	62.26	46.94	.7539
295.4	5.920	4.458	5.354	1.201
295.4	28.08	11.53	13.80	1.197
295.4	78.20	25.02	25.17	1.006
295.4	155.2	33.34	33.44	1.003
295.4	260.4	59.48	51.90	.8725
295.4	387.4	56.64	45.63	.8057
295.4	546.4	63.13	42.01	.6655
293.7	27.88	9.512	14.42	1.516
293.7	78.64	26.78	22.59	.8437
293.7	155.8	34.61	32.89	.9503
293.7	260.2	59.19	41.01	.6929
293.7	392.6	61.73	50.52	.8184
293.7	546.8	63.42	57.74	.9105



DATA QUALITY CHECK



F2A TEMPERATURE SHIFT FUNCTION AND ITS PROPERTIES



F3A GRAPHICAL PRESENTATION OF DAMPING MATERIAL COMPLEX MODULUS

$$log\ \alpha_T = a(1/T - 1/T_z) + 2.303\ (2a/T_z - b) log\ T/T_z + (b/T_z - a/T_z^2 - S_{Az})(T - T_z)$$

$$-d(log\ \alpha_T)/dT = a(1/T - 1/T_z)^2 + b\,(1/T - 1/T_z) + S_{Az}$$

Slope thru the three points:

$$T_z = A(1) = 300.,\quad S_{Az} = A(4) = 0.062$$

$$T_L = A(2) = 220.,\quad S_{AL} = A(5) = 0.173$$

$$T_H = A(3) = 340.,\quad S_{AH} = A(6) = 0.018$$

$$C_A = (1/T_L - 1/T_z)^2$$

$$C_B = 1/T_L - 1/T_z$$

$$C_C = S_{AL} - S_{Az}$$

$$D_A = (1/T_H - 1/T_z)^2$$

$$D_B = 1/T_H - 1/T_z$$

$$D_C = S_{AH} - S_{Az}$$

$$D_E = D_B\, C_A - C_B\, D_A$$

$$a = (D_B\, C_C - C_B\, D_C)/D_E$$

$$b = (C_A\, D_C - D_A\, C_C)/D_E$$

F2b Analytical Representation of the Temperature Shift Function

$$G = G_e + G_1/[1 + c_1\,(jf_R/f_1)^{-\alpha_1} + (jf_R/f_1)^{-\beta_1}]$$

$$G_e = B(1) = 1.8$$

$$G_1 = B(2) = 2130.$$

$$f_1 = B(3) = 0.22E6$$

$$\beta_1 = B(4) = 0.6$$

$$c_1 = B(5) = 2.2$$

$$\alpha_1 = B(6) = 0.16$$

F3b Analytical Representation of the Complex Modulus